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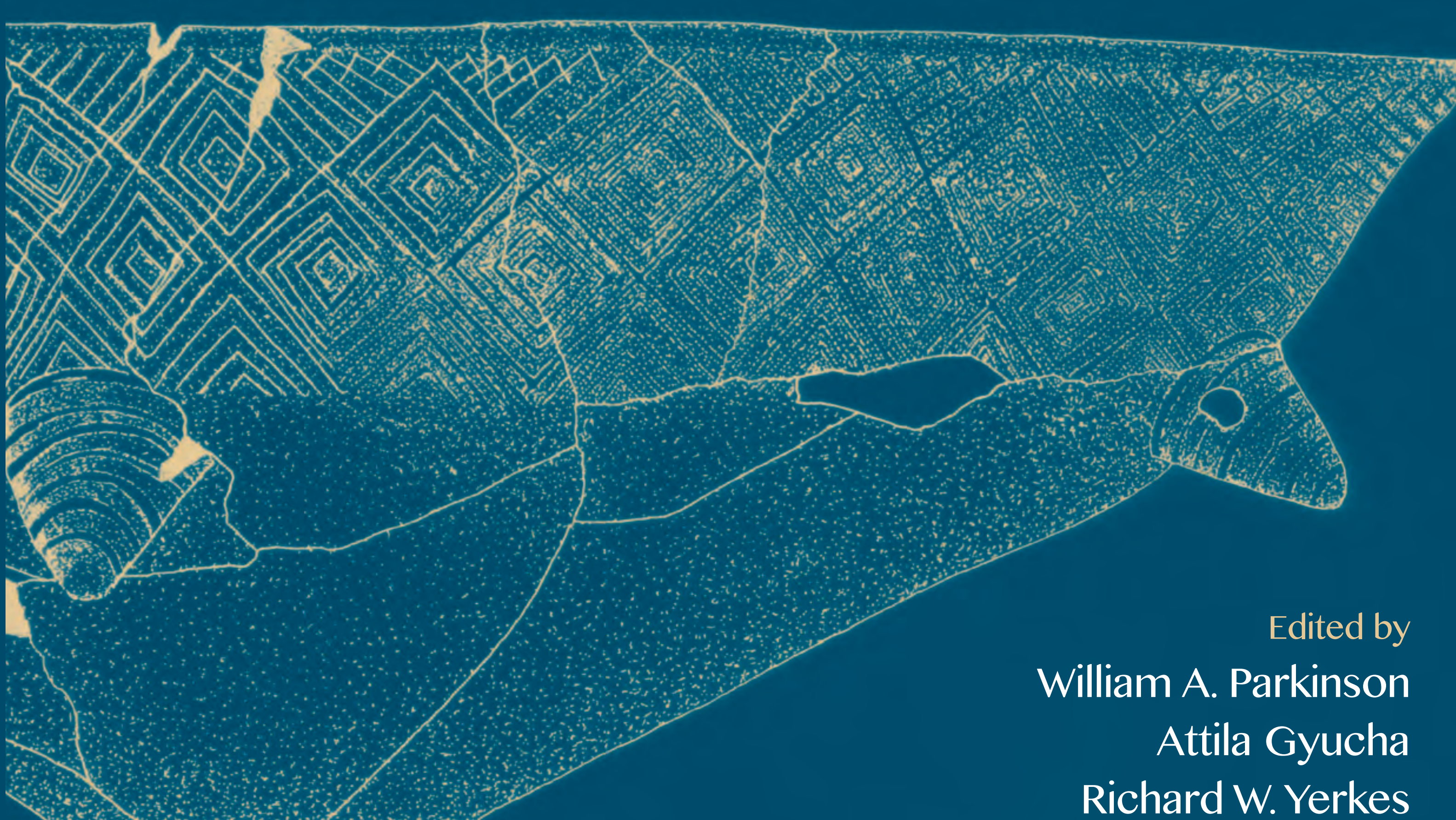

Edited by
William A. Parkinson
Attila Gyucha
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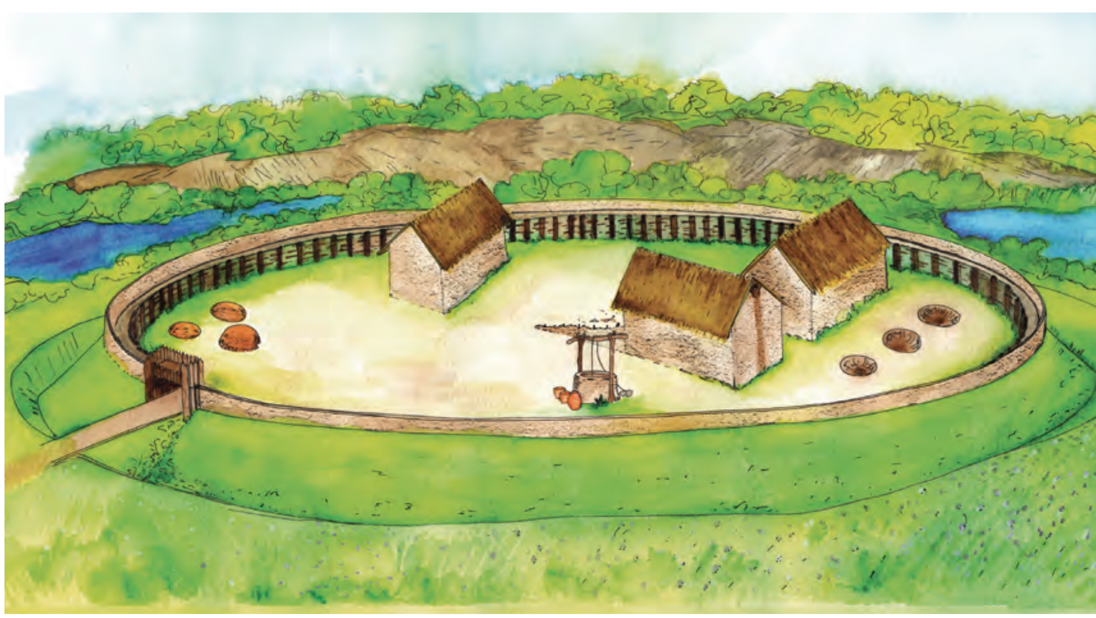

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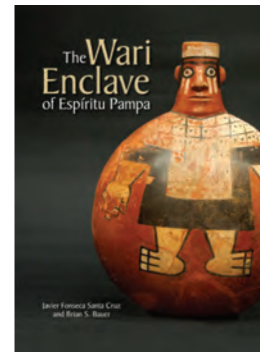

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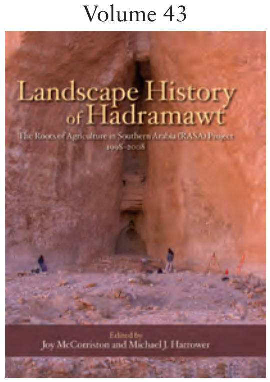

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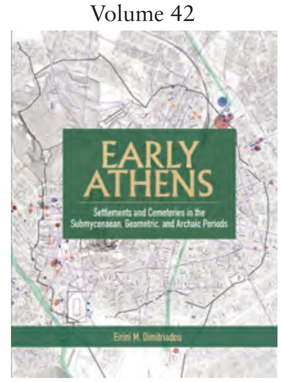

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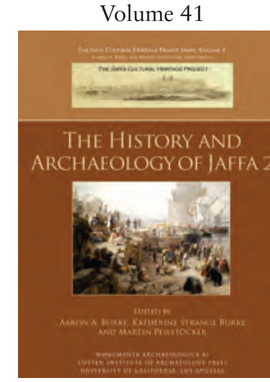

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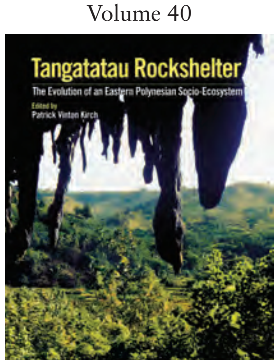

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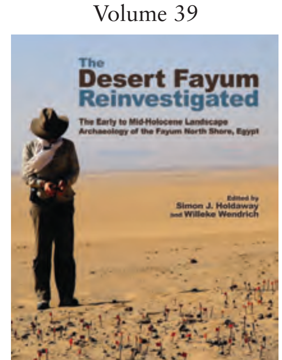

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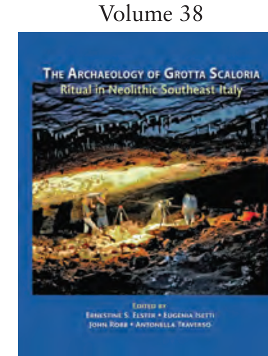

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Two Copper Age Villages
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Edited by
William A. Parkinson, Attila Gyucha, and Richard W. Yerkes

Monumenta Archaeologica 46

UCLA COTSEN INSTITUTE OF ARCHAEOLOGY PRESS

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Archaeology is a team sport, and we were extremely fortunate to get so much playing time with this amazing squad of all-stars. Our collaborative work in Hungary began more than two decades ago, and we cannot begin to thank everyone who has contributed to its success over the years (but here goes). First and foremost, we want to recognize the contributions of the students who participated in the project. The National Science Foundation Research Experience for Undergraduates Sites program provided critical funding for several years, and in many ways the project was built around the participants in that program (see Chapter 1 and Table 1.2). In addition to the American undergraduate students who received funding through the program, many undergraduate students from Hungary and other countries participated as volunteers (see Table 1.3). Many graduate students provided invaluable help, mentoring, and critical support. We worked with an incredible team of experts and specialists, who also served as student mentors. Some of the undergraduates came back as graduate students, and some of the graduate students came back as specialists. Some members of our team who started as students went on to establish their own projects in the region and, although we cannot claim credit for it, we remain incredibly proud of their success. A list of these project participants is available in Table 1.4. For the last two decades we have relied heavily on our relationships with the people of Vésztő and Békéscsaba, without whom none of this would have been possible. In addition to our friends in Vésztő and Békéscsaba who have tolerated us for so long, we also extend a special thanks to Dorottya Kékegyi, Paul Duffy, Julia Giblin, Roderick Salisbury, Amy Nicodemus, Kimberly Kasper, Margaret Morris Downing, Daniel Sosna, Timothy Parsons, Michelle Hughes Markovics, Nisha Patel, Gábor Bácsmegi, Ottó Fogas, Zsolti Bertalan, Robi Csülög, Csaba Gál, Csaba Jámbor, György Tószögi, the Kazai family, and the Tordai family. We thank the entire staff of the Munkácsy Mihály Múzeum for supporting the project since its inception. We also thank the Körösmenti Mezőgazdasági Szövetkezet, Sándor Rácz, and István Eszlári for permitting us to work on their land and Lexi bácsi, the Csóti family, and the Garzó family for keeping us well fed during field seasons—*köszönjük szépen*, Marika and Golyó! We thank the former mayors of Vésztő, Sándor Molnár, and János Kaszai, for their constant support of the project since we started. Unfortunately, János passed away a few years ago, as did our dear friend and best csabai sausage maker Lajos Laurinyecz. Two other project members, Jamie Waggoner and Noel Lanci, also passed away much too soon. We miss them all and hope this book will help honor their memory. We thank our various colleagues who supported our work over the years, including Pál Raczky, Ferenc Horváth, Katalin Hegedűs, Eszter Bánffy, Alice Choyke, László Bartosiewicz, Michael Galaty, Apostolos Sarris, Tod Frolking, Tibor Marton, and János Makkay. We also thank the staff at the Cotsen Institute of Archaeology Press, especially Randi Danforth and Aaron Burke, for their patience and professionalism as we prepared this manuscript. We also want to thank the copyeditor, Peg

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Part I

The Körös Regional Archaeological Project

Chapter 1

Introduction and Overview of the Körös Regional Archaeological Project

William A. Parkinson, Attila Gyucha, and Richard W. Yerkes

In Europe, as in many other parts of the world, a great deal of archaeological research in recent years has focused on how mobile hunting and gathering populations settled down and became sedentary farmers during the Holocene (e.g., Bogucki and Grygiel 1993; Childe 1929, 1958; Gronenborn 2007; Hodder 1991; Piggott 1965; Price 2000). Far fewer studies have examined the various changes that occurred within early farming villages after the adoption and initial spread of agriculture, when agropastoral communities created the new landscapes that most human societies now inhabit (cf. Balée 1998; Kendal et al. 2011; Rowley-Conwy and Layton 2011). Many critical changes in economic and political organization occurred within the social trajectories of these early farming villages, setting the stage for the world we live in today.

This book summarizes the results of the Körös Regional Archaeological Project's investigations into the social, political, and economic changes in the Körös region of the southeastern part of the Great Hungarian Plain during the transition from the Neolithic to the Copper Age (circa 4600–4400 cal BC; Figure 1.1).

The Late Neolithic period on the Great Hungarian Plain was characterized by settlement systems centered around tell sites, which were the focus of many archaeological projects throughout the twentieth century (see e.g., Kalicz and Raczky 1987a). Unlike their counterparts in the southern Balkans and the Near East, the tells of the Late Neolithic in the eastern Carpathian Basin were more short-lived, and most were abandoned by the beginning of the Copper Age, when smaller, more dispersed settlements were inhabited during the Tiszapolgár phase of the Early Copper Age. Historically, our understanding of the transition from the Neolithic to the Copper Age has been crippled by a lack of systematic research into Tiszapolgár villages. The research described here was designed specifically to provide information from Tiszapolgár settlements that could help us understand this important transition at the end of the Neolithic.

Building upon the extensive work of the Archaeological Topography of Hungary (Magyarország Régészeti Topográfiája, henceforth MRT) project in the Körös region, we performed our multidisciplinary research at two small, fortified Early Copper Age Tiszapolgár villages: Vésztő-Bikeri and Körösladány-Bikeri. Our research included not only systematic archaeological excavations at the Bikeri sites but also geophysical and geochemical surveys at these and other Early Copper Age settlements in the vicinity (Figure 1.2).

As a result of our investigations at Vésztő-Bikeri and Körösladány-Bikeri, we have gained important new insights into Early Copper Age social organization in the Körös region, but the data we present here can also help us understand the emergence of the Copper Age throughout

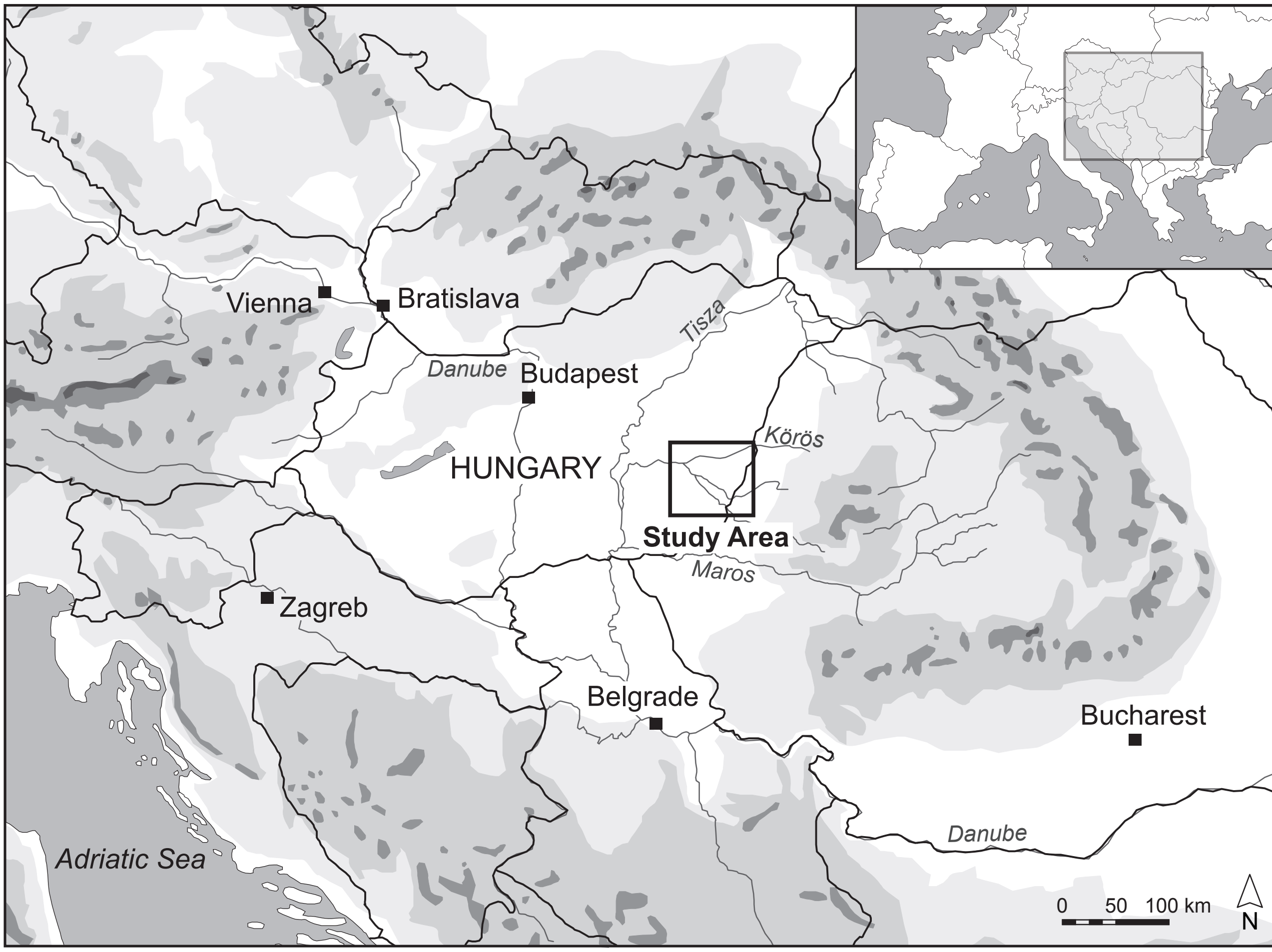

Figure 1.1. Location of the Körös Regional Archaeological Project study area in southeastern Europe. *Figure by Jill Seagard.*

central and southeastern Europe. These insights can also be utilized to explore similar trajectories of social change in early village societies elsewhere in the world.

In this introductory chapter, we present a summary of previous research on the Early Copper Age in the eastern Carpathian Basin and in our broader study region, the Körös Basin. We also describe our research goals and analytical framework. Finally, we provide a brief history of the explorations of the Körös Regional Archaeological Project between 1998 and 2007, with a specific emphasis on how we have integrated teaching into our research.

Previous Research on the Early Copper Age Tiszapolgár Culture

Not long after the Copper Age was inserted between the Stone Age and the Bronze Age in Thomsen and Worsaae's Three-Age System, studies of the period were initiated in Hungary (Hampel 1895; Pulszky 1884, 1897; Rómer 1866). The cultural characteristics of the Copper Age in the eastern Carpathian Basin (also called the Chalcolithic, Aeneolithic, or Eneolithic in central and southeastern Europe) were defined between World War I and World War II (Eisner 1933; Hillebrand 1933; Nestor 1933; Schroller 1933; Tompa 1937). Tompa began excavations at the Tiszapolgár-Basatanya cemetery in the upper Tisza region in 1929, and his work at the site was expanded by Bognár-Kutzián between 1950 and 1954. These pioneering investigations at Tiszapolgár-Basatanya provided most of the data used to define Tiszapolgár material culture (Bognár-Kutzián 1948, 1955, 1963) and continue to generate numerous related studies (Chapman 2000; Derevenski 1997, 2000; Gyucha and Parkinson 2013; Meisenheimer 1989, 1997; Pawn 2012; Raczky and Siklósi 2013; Skomal 1980, 1983). By the beginning of the twentieth century, the Deszk

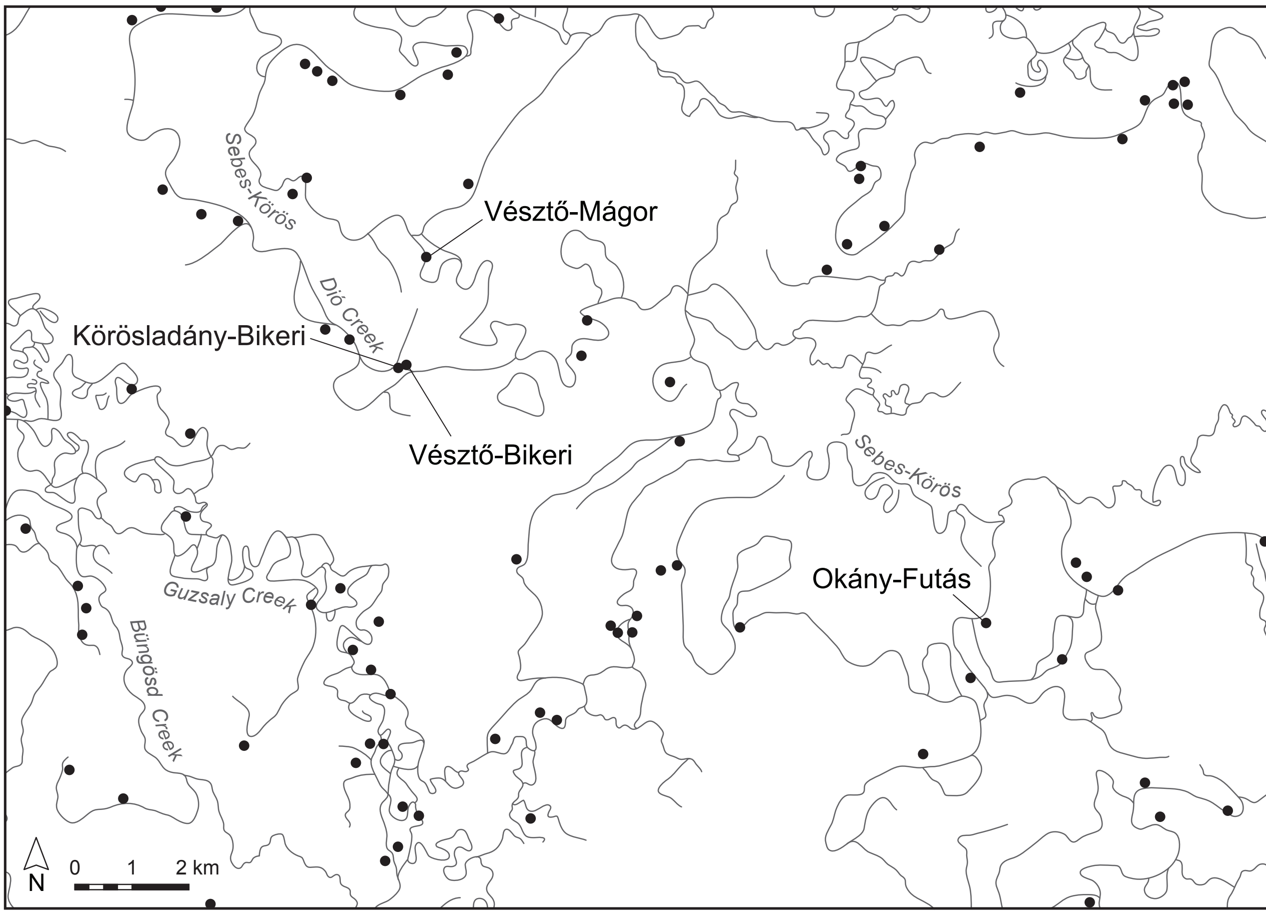

Figure 1.2. Sites investigated by the Körös Regional Archaeological Project. Black dots indicate other Early Copper Age sites in the eastern Körös region. Based on information from Gyucha et al. (2011) and Ecsedy et al. (1982). *Figure by Attila Gyucha, Richard W. Yerkes, and Jill Seagard.*

A and B and Hódmezővásárhely-Kotacpart cemeteries in the southern part of the Great Hungarian Plain also had been excavated and published (Banner 1934, 1935; Foltiny 1941; Párducz 1932). A few settlements, such as Tiszaug-Kisrétpart, had been investigated, although to a much smaller extent (Eisner 1933; Nestor 1933; Szabó 1934; Tompa 1937).

In the 1950s and 1960s, more Early Copper Age cemeteries, including Hódmezővásárhely-Népkert, Tápé-Lebő, and Debrecen-Nyulas, were discovered in the lower and middle Tisza River regions (Bognár-Kutzián 1972). Stratigraphic sequences at several multicomponent sites helped place the Tiszapolgár culture within the relative chronology for the Copper Age of southeastern Europe (Bognár-Kutzián 1963; Kalicz 1958; Korek and Patay 1956). It was not until the 1970s and 1980s, however, some 50 years after the archaeological investigations at Tiszaug-Kisrétpart, that a few more excavations were carried out at small Tiszapolgár settlements on the Great Hungarian Plain, including Tiszaföldvár-Újtemető, Szolnok-Zagyvapart, and Battonya-Vertán, but most of this research was not published until much later (Goldman and Szénászky 2012; Siklódi 1982, 1983; Szilágyi 2010). More recently, rescue excavations associated with infrastructural developments identified Tiszapolgár settlements and burials. Of these, only a few, such as Hódmezővásárhely-Laktanya and Hajdúböszörmény-Ficsori-tó, have been published (Kovács and Váczi 2007; Patay 2008).

Excavations at the foothills of the northern Carpathians in Slovakia exposed Tiszapolgár settlement features and graves at Lúčky (Šiška 1968). Nearby, at Tibava, 41 graves were unearthed between 1955 and 1957 (Andel 1961; Šiška 1964), while at Vel'ké Raškovce, 44 burials were discovered in 1974 (Vizdal 1977). Settlements at Vel'ké Raškovce and Oborín also were investigated (Šiška 1963; Vizdal 1964). Data from these sites helped establish the chronological position and cultural connections of the Lúčky group of the Tiszapolgár culture (Novotnỳ 1958; Pavúk 1983; Pavúk and Šiška 1971, 1981; Šiška 1968). In the 1960s, based on the ceramic assemblage from Oborín that exhibited both Neolithic and Copper Age attributes, a transitional stage from the Neolithic to the Copper Age was proposed—the Proto-Tiszapolgár phase (Lichardus and Vladár 1964; Šiška 1968). Layers associated with the Proto-Tiszapolgár phase also were identified on the Great Hungarian Plain in the Neolithic tell strata of Hódmezővásárhely-Gorzsa (Horváth 1987, 2005) and Berettyóújfalu-Herpály (Kalicz and Raczky 1986, 1987b). However, the concept of Proto-Tiszapolgár recently has been rejected by some scholars (Horváth 2014; Raczky and Anders 2016; see also Chapter 9, this volume). Sites representing a possible transition in ceramic style between the Neolithic and Copper Age were noted in the southern part of the Great Hungarian Plain, in Hungary (Deszk-Ordos, Deszk-Vénó, and Darvas-Kisbogárzó) and also in parts of the former Yugoslavia (Gomolava, Sirig-Kamendin, and Gospodinci-Parohija), but these results have not been published in detail (Brukner et al. 1974:440–41; Horváth 1985; Tasić 1979:62–64).

In western Romania, investigations at Dăbîca, Oradea-Salca, Gilău, Sântana-Holumb, and Homorodu de Sus have helped define the eastern distribution of Tiszapolgár material culture (Dumitraşcu 1975; Iercoşan and Bader 1999; Kalmar 1980; Lazarovici 1983; Rusu et al. 1962; Vlassa 1969). As a result of excavations at these sites, the relative position of Tiszapolgár in the chronological framework of the Romanian Copper Age was established and its relationship with contemporaneous cultures was explored (Andriţoiu 1985; Horedt 1968; Lazarovici 1976, 1979, 1983; Luca 1999; Oprinescu 1981; Roman 1971; Vlassa 1976). More recent excavations of flat sites and the uppermost layers of Neolithic tells with Tiszapolgár settlement and burial features in Romania have occurred at Carei-Cozard, Parţa, and Uivar (Iercoşan 1999; Lazarovici et al. 2001; Luca 2001; Schier 2008; Schier and Draşovean 2004).

In Serbia, important excavations took place at the Crna Bara tell (Garašanin and Garašanin 1957), as well as at Senta (Korek 1958), Srpski Krstur, and Sirig-Kamendin (Milleker 1893; see also Bognár-Kutzián 1972). In contrast to the Great Hungarian Plain, most of the data on the Tiszapolgár culture in Romania and Serbia come from settlements; only a few burials and cemeteries have been published from these countries (e.g., Grčki-Stanimirov and Stanimirov-Grčki 1996).

Summaries of regional variants of the Tiszapolgár culture came out in the 1970s (Brukner et al. 1974; Tasić 1979), but Bognár-Kutzián's monographs remain the most comprehensive (Bognár-Kutzián 1963, 1972). She meticulously described each of the known Tiszapolgár sites, plotted the distribution of the settlements and cemeteries, produced the artifact typology, established the relative chronology, and discussed the settlement characteristics, burial customs, subsistence practices, origins of the culture, and its relationship to both neighboring and more remote cultural complexes. Based on variations in ceramic style, she subdivided the Tiszapolgár culture into four regional components: the Basatanya, Deszk, Tiszaug-Kisrétpart, and Lucska groups. Siklódi (1984) attempted to update the characteristics of the Kisrétpart group in her doctoral dissertation. More recently, Iercoşan (2002) and Diaconescu (2009) summarized the studies of Tiszapolgár culture in western Romania. Parkinson (2006a, 2006b) demonstrated that some of the Tiszapolgár cultural groups originally identified by Bognár-Kutzián are based on specific decorative attributes that are distributed in a clinal fashion across the landscape, suggesting less well-maintained and more permeable boundaries than during the preceding Late Neolithic period.

In past decades, Tiszapolgár and neighboring archaeological cultures frequently have been discussed in association with copper artifacts and the development of metallurgy in southeastern Europe (Bognár-Kutzián 1972; Borić 2009; Jovanović 1971, 1990; Kalicz 1992; Makkay 1996; Muhly 1988; Patay 1983; Renfrew 1969). The absolute chronology of the period, which was established by the mid-1990s (Bognár-Kutzián 1985; Gläser 1996; Hertelendi et al. 1995; Raczky 1995a), recently has been challenged by new radiocarbon dates and Bayesian statistical approaches that suggest that the Copper Age may have started earlier in some parts of the Carpathian Basin (Csányi et al. 2010; Diaconescu 2013, 2014; Raczky and Siklósi 2013; Yerkes et al. 2009; see also Chapter 8, this volume).

Previous Research on the Tiszapolgár Culture in the Körös Region

Early excavations at Tiszapolgár sites in the study area were conducted near Dévaványa in the 1940s and 1950s. Later, several Tiszapolgár sites identified during the MRT survey program were excavated, including Bélmegyer-Mondoki-domb (Goldman 1977), Dévaványa-Réhely (Ecsedy et al. 1982:44–45), Endrőd-Öregszőlők IV (Jankovich et al. 1989:142–43), and Endrőd-Hegedűs-tanya (Jankovich et al. 1989:163–64).

Tiszapolgár artifacts were also found during the excavations of the Neolithic tell sites at Szeghalom-Kovácshalom and Körösújfalu-Jákó-halom at the end of the 1960s (Bakay 1971; Ecsedy et al. 1982:129). An Early Copper Age stratum, 90–100 cm thick, was documented during investigations conducted by Hegedűs at the multicomponent tell of Vésztő-Mágor. Subsequent excavations in the 1970s and 1980s at the site recovered Tiszapolgár settlement and burial features (Hegedűs 1982; Hegedűs and Makkay 1987).

As part of a British–Hungarian project directed by Sherratt, some Early Copper Age sites were investigated on the Dévaványa Plain in the northern Körös Valley in the 1970s and 1980s (Sherratt 1983a, 1984). In the 1980s, Nikolin unearthed six Tiszapolgár graves at Okány-Baromfitelep (Gyucha 2015). Several sites with Early Copper Age components were excavated during an interdisciplinary research project led by the Archaeological Institute of the Hungarian Academy of Sciences in the western part of the Körös region near Gyomaendrőd during the 1980s (Bökönyi 1992, 1996), but only partial results from Endrőd-Polyák-alja have been published (Zalai-Gaál 1998). Over the course of rescue excavations for a water reservoir at Gyula-Remete-Iskola, Gyucha and Medgyesi exposed several Tiszapolgár settlement features and graves in the 1990s (Gyucha 2015; Gyucha et al. 2002).

Goals, Scope, and Analytical Framework of the Körös Regional Archaeological Project

Since 1998, the Körös Regional Archaeological Project has built on previous research in the region by generating new data from excavations at the Early Copper Age settlements of Vésztő-Bikeri and Körösladány-Bikeri and from various surveys designed to examine the structural and operational characteristics of Early Copper Age settlements in the Körös region.

Investigating the organization of Tiszapolgár settlements is important not only for understanding the development of early farming villages in the region but also because at the end of the Neolithic, around the middle of the fifth millennium BC (Table 1.1), the agricultural societies in the Körös region underwent fundamental transformations (Gyucha et al. 2009; Parkinson 2002; Parkinson and Gyucha 2007; Parkinson et al. 2010b). The archaeological record indicates that many aspects of social organization changed during the transition from the Neolithic to the Copper Age:

1. The three geographically discrete, archaeologically defined cultural groups of the Late Neolithic on the Great Hungarian Plain—the Tisza–Herpály–Csőszhalom complex—gave way to the more homogeneous Early Copper Age Tiszapolgár cultural complex, which extended across the entire plain and into the foothills of southern Slovakia and

Table 1.1. Simplified Middle Neolithic to Copper Age cultural chronology for the Great Hungarian Plain

Absolute Chronology (cal BC)	Period	Central and Southern Plain	Northern Plain	Eastern Plain/ Körös–Berettyó Rivers
3500–3000	**Late Copper Age**	Baden, Boleráz	Bodrogkeresztúr	Baden, Boleráz
4000–3500	**Middle Copper Age**	Bodrogkeresztúr	Bodrogkeresztúr	Bodrogkeresztúr, Hunyadihalom
4500–4000	**Early Copper Age**	Tiszapolgár	Tiszapolgár	Tiszapolgár
5000–4500	**Late Neolithic**	Tisza	Tisza, Csőszhalom	Tisza, Herpály
5400–5000	**Middle Neolithic**	Alföldi Vonaldíszes Kerámia (Alföld Linear Pottery or AVK), Szakálhát	Alföldi Vonaldíszes Kerámia (Alföld Linear Pottery or AVK), Tiszadob, Bükk	Alföldi Vonaldíszes Kerámia (Alföld Linear Pottery or AVK), Szakálhát, Esztár

Note: Based on Parkinson (2006a:Figure 4.4), Parkinson et al. (2010b:Table 1), and Yerkes et al. (2009). *Table by Richard W. Yerkes.*

western Romania (Bognár-Kutzián 1972; Gyucha 2015; Iercoşan 2002; Parkinson 2006a; Šiška 1968).

2. Late Neolithic tells and large horizontal settlements were abandoned, and the surrounding settlement clusters dissolved. Communities living in these nucleated Late Neolithic site complexes dispersed and established smaller, more ephemeral, scattered settlements that signaled the beginning of the Early Copper Age. In the Körös region, there was nearly a sevenfold increase in the number of sites during the Early Copper Age (Gyucha 2015; Gyucha and Parkinson 2013; Gyucha et al. 2009; Parkinson 2006b; Parkinson et al. 2004b, 2010b).

3. Substantial longhouses, often with multiple rooms and sometimes with multiple stories, were found on several Late Neolithic settlements on the Great Hungarian Plain (Horváth 1987, 1989; Kalicz and Raczky 1984; Raczky 2009; Raczky et al. 2002). Before our excavations at Vésztő-Bikeri and Körösladány-Bikeri, the few Early Copper Age houses that had been only partially excavated appeared to be small, single-room structures (Bognár-Kutzián 1972:164–72).

4. The first formal cemeteries separated from domestic sites were established in the region at the beginning of the Early Copper Age (Bognár-Kutzián 1963).

5. The distribution of lithic materials suggests that long-distance trade networks were altered by the Early Copper Age (Biró 1991; Gyucha and Parkinson 2013).

Previous explanations for the changes that occurred during the Neolithic–Copper Age transition included the invasion of Proto-Indo-Europeans on horseback (Gimbutas 1977, 1982, 1991; Mallory 1989), climatic changes resulting in a shift toward pastoralism in the subsistence strategy (Bánffy 1994; Bognár-Kutzián 1972; Horváth 2005; Siklódi 1982, 1983), population demographics giving rise to scalar stress in nucleated Late Neolithic communities (Horváth 1986; Kalicz 1988; Makkay 1982; Parkinson 2002, 2006a, 2006b), and conflicts between sedentary farmers and mobile pastoralists on the Great Hungarian Plain (Ecsedy 1981; Horváth 1989).

Research Questions

By the end of the twentieth century, archaeologists had completed several substantial research projects at Late Neolithic tells and large horizontal sites on the Great Hungarian Plain (Hegedűs and Makkay 1987; Horváth 1987, 2005; Kalicz and Raczky 1987a, 1987b; Korek 1987; Raczky 1987, 1995b, 1998; Raczky et al. 1994, 2002, 2007). But the almost complete lack of systematic investigations at Early Copper Age settlements made it nearly impossible to model the social, economic, and cultural transformations that occurred at the end of the Neolithic. By studying the Bikeri sites in a broader regional and temporal framework, the Körös Regional Archaeological Project sought answers to specific questions about the organization of Early Copper Age settlements that were critical for understanding the transition to the Copper Age throughout southeastern Europe more broadly. These questions included:

1. How large and how long-lived were Early Copper Age settlements compared to Late Neolithic sites?

2. How were Early Copper Age settlements organized spatially, and what can their organization tell us about community organization?

3. How did the domestic economy of Early Copper Age settlements, as represented in faunal and floral assemblages, differ from that of Late Neolithic settlements?

4. How was the trade, exchange, and production of durable materials, such as lithic artifacts, ceramics, and metals, organized in the Early Copper Age?

5. What factors played the most important role in the transition from the Neolithic to the Copper Age? Were these factors primarily environmental, political, economic, or ideological in nature?

In addition to previous excavations at the Vésztő-Mágor tell (Hegedűs and Makkay 1987; Makkay 2004), the results of the MRT survey program provided a firm foundation for our investigations with respect to regional analysis. The primary goal of the MRT project was to identify and map sites by means of pedestrian surface survey. Researchers attempted to outline how large sites were and used diagnostic artifacts to identify their chronology (Ecsedy et al. 1982; Jankovich et al. 1989, 1998). The MRT project was launched by the Archaeological Institute of the Hungarian Academy of Sciences in the northern part of Békés County in the late 1960s. By the middle of the 1990s, an area of 3,798 km^2 was covered in the Körös region and the northern part of the Maros Fan, which is directly south of the Körös Basin (see Chapter 3, this volume). More than 8,000 archaeological sites were registered during the course of this research. Previous investigations by Hungarian (Bökönyi 1992, 1996), British (Sherratt 1983a, 1984; Whittle 2007), and American (Parkinson 1999, 2006a, 2006b) teams used this excellent dataset for micro-regional and regional analyses.

The Körös Regional Archaeological Project utilized the MRT data to model the spatial organization of Late Neolithic and Early Copper Age settlements throughout the Körös region. Other questions were approached with micro-regional systematic surface collection, soil chemistry studies, geophysical surveys, excavations, and geomorphological research at Vésztő-Bikeri, Körösladány-Bikeri, and Vésztő-Mágor as well as at another small Tiszapolgár settlement in the micro-region, Okány-Futás (Figure 1.2). By integrating noninvasive research with systematic excavations, our aim was to develop a settlement model for the Early Copper Age sites in this region that would let us reconstruct the changes in household and settlement organization that occurred during the transition from the Neolithic to the Copper Age.

Analytical Framework: Integration, Interaction, and Multiple Scales of Analysis

To address our research questions, we developed an analytical framework that examined levels of *integration* and *interaction* in Early Copper Age societies (Gyucha et al. 2009; Gyucha and Parkinson 2013; Parkinson 2006a; Parkinson and Gyucha 2007; Parkinson et al. 2010b). Integration and interaction are intimately intertwined social dimensions helpful in modeling social organization in prehistoric villages (Caldwell 1964; Hall 1997; Parkinson 2002, 2006b; Steward 1951). Following Parkinson (2002), the term *integration* here refers to social relationships and processes that link people together into decision-making units. This can occur within households or other segments within a settlement, but integration also is a process wherein different settlements can link up with each other to form regional communities (Neitzel 1999; Parkinson et al. 2010b; Peterson and Drennan 2005). The scale of, and relationship between, the different integrative units is essential for modeling social organization within tribal or autonomous village societies, which are often acephalous, decentralized, and segmented (Braun and Plog 1982; Parkinson 2002; Whallon 1968).

Interaction is a more general term that refers to how individuals relate to each other between those social units of integration. Interaction processes occur *between* individuals and groups from different societies that establish some type of ritual, economic, or political contact with "others." Hall (1997:155–56) described how Caldwell (1964) defined an Interaction Sphere between regions where tribal societies have their own local cultural traditions but share the ideology and symbols of Great Traditions with other tribes. For Caldwell and Hall, interaction is a process that facilitates the exchange of materials and ideas throughout an Interaction Sphere, which is the geographical theater of these activities. The body of shared ideas, values, and symbols, and the common styles of artifacts, are part of the Great Tradition that united, and also helped integrate, dispersed groups within an Interaction Sphere. Interaction also can be examined at several different scales, but we envision the relationships between the dispersed Early Copper Age settlements in the eastern Carpathian Basin as having occurred within a Tiszapolgár Interaction Sphere.

Understanding how integration and interaction operate at one scale can help clarify processes operating at other scales. By understanding interaction at the scale of the household or settlement, it is possible to model how interactive processes may have operated at the larger community and regional scales. Conversely, models of interaction within regions can be used to help understand local processes (Gyucha and Parkinson 2013; Parkinson 2002, 2006b).

The prehistory of the Körös region indicates patterned, long-term shifts in the processes of integration and interaction throughout the Neolithic and the Bronze Age. Parkinson (2002) called this "tribal cycling" and compared it to the kinds of cycles others have identified in chiefdoms (Anderson 1996) and states (Marcus 1998, 2012). In those cases, however, the cycling was associated with new political and economic institutions, including increasing hereditary inequality, social stratification, craft specialization, and even market systems. Tribal cycling, by contrast, is a more fluid process that occurs in the absence of institutionalized central authority. While incipient forms of hereditary ranking and economic complexity occurred during the prehistory of the region, in the case of the Neolithic, this never led to the emergence of hierarchical chiefdoms (cf. Earle 1997). These "false starts" along the road to increasing social complexity are just as significant in the study of ancient culture change as examples of when the process was completed—as it was in some parts of the Carpathian Basin during the Bronze Age (Duffy 2014; Duffy et al. 2013).

Brief History of the Körös Regional Archaeological Project Investigations, 1998–2007

During his dissertation work in 1998, Parkinson revisited 47 Early Copper Age sites that previously had been identified by the MRT. He performed systematic surface collections at 11 of them to estimate site size and to collect samples for analyzing stylistic variability in ceramic assemblages. He compared this new data with information from other sites recorded in the MRT survey and with data from previous excavations at Vésztő-Mágor and Örménykút-Maczonkai-domb (for details and references, see Parkinson 2006a, 2006b). The results of these analyses showed how tribal boundaries and levels of social integration and interaction between settlements in the Körös region changed over time.

Parkinson's dissertation research raised new questions about the socioeconomic transformations that occurred during the Neolithic–Copper Age transition. To answer them, it was necessary to launch investigations aimed specifically at Tiszapolgár settlement sites within their micro-regional and regional contexts. Drawing on our experiences with integrated survey and excavation projects in Cyprus, Greece, and the United States, we developed a multiscalar research design to address these questions (cf. Davis et al. 1997; Phillips et al. 1980; Toumazou et al. 1998, 2011; Yerkes 2000). Detailed geomorphological and paleoenvironmental reconstructions of the Körös region were based on historical and modern maps, aerial imagery, geochemical analyses of soil and sediment samples, and preserved macrobotanical and faunal remains (Frolking 2004; Gyucha and Duffy 2008; Gyucha et al. 2011; see also various chapters in this volume). To complement these regional and micro-regional datasets, systematic excavations at Early Copper Age settlements provided us with spatial information and temporal contexts for subsistence practices, economic activities, and community organization.

The MRT surveys had located and described 394 Early Copper Age sites in the 3,798 km^2 survey area in northern Békés County, but the small, dispersed Tiszapolgár culture sites were believed to have been short-lived, with shallow subsurface features that were not likely to have survived the centuries of erosion and plowing. However, when Parkinson revisited two of these Tiszapolgár sites near the modern town of Vésztő in 1998, he discovered concentrations of burned daub and other archaeological materials on the surface, indicating that intact remains of Early Copper Age structures and other features were preserved below the plowzone.

Figure 1.3. Aerial photograph showing the location of the Bikeri sites on opposite sides of the Dió Creek, facing southeast. *Figure by William A. Parkinson.*

These two adjacent Early Copper Age Tiszapolgár sites, Vésztő-Bikeri and Körösladány-Bikeri, are located only about 70 m apart (Figure 1.3) and 2 km south of the multi-component Vésztő-Mágor tell, which also has a Tiszapolgár layer (Hegedűs and Makkay 1987; Makkay 2004). Based on systematic surface collections at the site, Vésztő-Bikeri appeared to be a single-component Tiszapolgár village (Parkinson 2006a:117, 2006b). Across the modern canal dug into the ancient meander of the Dió Creek, at the Körösladány-Bikeri site, the majority of the material recovered by the MRT survey team and by Parkinson's 1998 surface collections suggested that the site dated primarily to the Early Copper Age (Ecsedy et al. 1982:206; Parkinson 2006a:102). However, a few sherds from the Middle Copper Age (Bodrogkeresztúr culture, circa 4000–3500 cal BC), the Late Bronze Age (Gáva culture, circa 1300–900 cal BC), the Sarmatian period (second to fourth century AD), and the Árpádian Age (eleventh to thirteenth century AD) also were recovered at Körösladány-Bikeri.

The Vésztő-Bikeri and Körösladány-Bikeri sites were selected for test excavations to determine:

1. If intact, undisturbed Early Copper Age features were preserved below the plowzone.

2. If the two adjacent village sites were occupied by the same community during the Early Copper Age.

3. If it would be possible to collect data related to community organization, subsistence practices, seasonality, and duration of occupation at each village.

Our excavation methods combined Hungarian and American techniques and allowed the detailed documentation of the spatial relationship between features and artifacts. Although the ultimate goal was to recover the maximum amount of information about the sites through the complete excavation of features and the piece plotting of any in situ materials on floors and living surfaces, the first step was an assessment of the integrity of the subsurface archaeological strata at these two small Early Copper Age villages.

Although our work concentrated primarily on the Bikeri sites, we also conducted limited research at another small Early Copper Age site, Okány-Futás, as well as at the nearby Vésztő-Mágor tell, to add a micro-regional perspective to our investigations.

A wide variety of noninvasive techniques also were employed during the course of the project. We conducted systematic, intensive, gridded surface collections at Körösladány-Bikeri in 2005 and at Okány-Futás in 2006 to acquire high-resolution spatial information for modeling site extent and organization. Geophysical investigations were used routinely after 2001 to map the layout of sites and to identify anomalies related to subsurface features. In addition to magnetometry surveys, we also collected soil samples for magnetic susceptibility measurements. Soil chemistry investigations were performed at both Bikeri sites in 2002 and 2003, and also at Okány-Futás in 2006 and 2007. The results of the excavations and the noninvasive surveys were integrated into a unified GIS database. Additional paleogeomorphological studies occurred in the vicinities of the Bikeri sites and Vésztő-Mágor, as well as along the Sebes-Körös and Hármas-Körös Rivers in 2001, 2002, and 2005.

The excavations started with small test units at Vésztő-Bikeri in 2000 and lasted until 2003. At Körösladány-Bikeri, trial trenches were opened in 2001 and large-scale excavations took place in 2005 and 2006. Two lab seasons closed each phase of the project, in 2004 and 2007.

From 2000 to 2007, funding from the National Science Foundation (NSF-0097230, NSF-0105851, NSF-0139122, NSF-0243583), the Hungarian Scientific Research Fund, the Wenner-Gren Foundation for Anthropological Research (ICRG-2001), The Ohio State University, and Florida State University supported our investigations.

Integrating Teaching and Research

Many of the authors of the chapters in this book were students in our National Science Foundation–sponsored archaeological field schools in 2001–2003 and 2005–2006. Others were graduate students who used data from the Körös Regional Archaeological Project in their theses and dissertations. Funding from the NSF Research Experiences for Undergraduates (REU-Site) program, an NSF International Cooperative Grant, and several NSF Doctoral Dissertation Improvement Grants allowed us to provide training for future anthropologists and archaeologists as part of our international, multidisciplinary research. Undergraduate and graduate students from the United States and Europe participated in the systematic excavations at Vésztő-Bikeri and Körösladány-Bikeri. They also assisted specialists with their geophysical prospection, soil chemistry, intensive surface collection, and paleoenvironmental studies. With support from the grants, we were able to provide training and international research experiences for 66 participants from the United States and 16 from Europe. Fifty American students used

Table 1.2. American students supported by NSF Research Experiences for Undergraduates (NSF-REU) grants and their independent research projects, 2001–2006

Student	Independent REU Undergraduate Research Project	Year	College or University	Supervisor
Bleckley, David	Diet and seasonality from plant remains	2001	University of Michigan	W. A. Parkinson
Boyd, Christine H.	Environmental reconstruction	2001	University of Pittsburgh	T. A. Frolking
Echols, Emily R.	Bone tool production and exchange	2001	The Ohio State University	A. Choyke
Gamble, Summer	Stylistic variability of ceramics	2001	The Ohio State University	A. Gyucha
Hammer, Daniel	Evaluating geophysical techniques	2001	The Ohio State University	A. Sarris
King, Ellen	Feature patterns and activities	2001	The Ohio State University	R. W. Yerkes
Kompanek, James	Technology of ceramic manufacturing	2001	University of Pittsburgh	W. A. Parkinson
Parsons, Timothy A.	Clay sources and ceramic manufacturing	2001	Millsaps College	M. L. Galaty
Patel, Nisha	House construction techniques	2001	The Ohio State University	W. A. Parkinson
Swafford, Amber	Domesticated animal remains	2001	Kansas State University	R. W. Yerkes
Billingsley, Doc	Soil chemistry studies	2002	Millsaps College	M. L. Galaty
Dale, Stephanie M.	Fabric analysis of pottery	2002	Florida State University	W. A. Parkinson
Duwe, Samuel G.	Neutron activation analysis of ceramics	2002	University of Michigan	H. Neff
Frame, Lesley D.	Copper tool production and exchange	2002	MIT	H. Lapham
Horn, Sherman	Bone tool production	2002	The Ohio State University	R. W. Yerkes
Jadoo, Hardai S.	Textile production	2002	University of Florida	A. Choyke
Lanci, Noel P.	Faunal remains	2002	University of Kansas	R. W. Yerkes
McCubbin, Gwyneth	Paleobotanical analysis	2002	Penn State University	W. A. Parkinson
Purdin, Bethany	Paleoenvironments of meander loops	2002	Florida State University	T. A. Frolking
Tate, Robert R.	Geophysical survey results	2002	The Ohio State University	A. Sarris
Blatt, Samantha	Fortifications and conflict	2003	Rutgers University	R. W. Yerkes
Bolton, Jennifer	Floral remains	2003	Florida State University	W. A. Parkinson
Freiert, Joanna	Ceramic form and function	2003	The Ohio State University	A. Gyucha
Giblin, Julia	Strontium isotopes in human remains	2003	Florida State University	W. A. Parkinson
Kurgan, Kathleen	Ceramic sociology	2003	Penn State University	A. Gyucha
Lee, Elizabeth	Phosphate analysis of soils	2003	University of California–Berkeley	R. W. Yerkes, T. A. Frolking

Student	Independent REU Undergraduate Research Project	Year	College or University	Supervisor
Morris, Margaret	Intrasite analysis with GIS	2003	The Ohio State University	R. W. Yerkes
Plueard, Jessie	Copper Age exchange systems	2003	Southern Oregon University	W. A. Parkinson
Roberts, Tim	Wild versus domestic animal exploitation	2003	Florida State University	R. W. Yerkes
Sonneborn, David	Feature patterns and activity areas	2003	Columbia University	W. A. Parkinson
Bruni, Phil	Early Copper Age fortifications	2005	University of Illinois at Chicago	R. W. Yerkes, L. Keeley
Gurciullo, Kristen	Analysis of flotation samples	2005	Florida State University	W. A. Parkinson
Horobik, Heather	GIS study of surface artifact distributions	2005	Albion College	A. Sarris
LeDuc, Matthew*	Replicating Early Copper Age ceramics*	2005	University of Michigan	W. A. Parkinson
Warner, Walter*	Replicating Early Copper Age ceramics*	2005	Florida State University	*joint project
Mattoon, Jocelyn*	Stylistic analysis of ceramics*	2005	Kansas State University	A. Gyucha
Schiszik, Lauren*	Stylistic analysis of ceramics*	2005	Earlham College	*joint project
Sauer, Erin	Regional paleohydrology	2005	The Ohio State University	T. A. Frolking
Alex Tebben	Ceramic function in houses	2005	The Ohio State University	R. W. Yerkes
Weinstein, Mara	Faunal remains	2005	The Ohio State University	R. W. Yerkes
Deppen, Jacob	Regional paleohydrology	2006	The Ohio State University	R. W. Yerkes
Eudy, Douglas	Spatial distributions of ceramics	2006	Truman State University	A. Gyucha
Lane, Molly	Human burials	2006	The Ohio State University	R. W. Yerkes, J. Giblin
Nathan, Smiti	Soil chemistry	2006	George Washington University	T. A. Frolking
Neff, Margaret	GIS analysis of geophysical surveys	2006	University of Arizona	A. Sarris
Reynolds, Sean	Surface patterns	2006	Florida State University	W. A. Parkinson
Shum, Annalee	Technology of ceramic manufacturing	2006	Florida State University	W. A. Parkinson
Smith, Abigail	Floral remains	2006	Rice University	W. A. Parkinson, K. Kasper
Strand, Katherine	Fortifications	2006	University of Wyoming	R. W. Yerkes
Vidal, Juan R.	Changes in ceramic styles	2006	University of Cincinnati	A. Gyucha

NSF–REU funding to complete independent research projects (Table 1.2). Fifty American participants earned master's degrees (76 percent), and 23 of them continued in PhD programs (33 percent). Seven American participants have completed their doctorates. One of them holds a tenure-track position at Southern Methodist University. Others have recently received tenure at Quinnipiac University and the University of Oklahoma. Other former students have faculty appointments at the University of Toronto and Rhodes College, and positions with the federal government or private CRM firms.

All the European participants completed the equivalent of a master's degree (Table 1.3). Four have earned their doctorates and hold academic or research appointments. Ten American undergraduate participants expanded their field school projects into undergraduate honors theses, five completed master's theses that grew out of Körös Regional Archaeological Project investigations, and seven Hungarian and American students used Körös Regional Archaeological Project data in their doctoral dissertations. NSF–REU participants have used data from their field school projects in 71 posters, papers, articles,

Table 1.3. Undergraduate student participants on the project, 2000–2006

Student	College or University	Year
Bácsmegi, Gábor	University of Szeged, Hungary	2000–2002
Balogh, Judit	University of Szeged, Hungary	2000
Billingsley, Doc	Millsaps College, USA	2002
Blatt, Samantha	Rutgers University, USA	2003
Bleckley, David A.	University of Michigan, USA	2001
Bóka, Gergely	University of Szeged, Hungary	2002–2006
Bolton, Jennifer	Florida State University, USA	2003
Boyd, Christine H.	University of Pittsburgh, USA	2001
Bruni, Phil	University of Illinois at Chicago, USA	2005
Cséki, Andrea	University of Szeged, Hungary	2000–2001
Dale, Stephanie M.	Florida State University, USA	2002
Deppen, Jacob	The Ohio State University, USA	2006
Duwe, Samuel G.	University of Michigan, USA	2002
Echols, Emily R.	The Ohio State University, USA	2001
Eichman, William	University of Wisconsin, USA	2003
Eudy, Douglas	Truman State University, USA	2006
Fogas, Ottó	University of Szeged, Hungary	2000–2002
Frame, Lesley D.	Massachusetts Institute of Technology	2002
Freiert, Joanna	The Ohio State University, USA	2003
Gamble, Summer	The Ohio State University, USA	2001
Giblin, Julia	Florida State University, USA	2003
Gurciullo, Kristen	Florida State University, USA	2005
Hammer, Daniel	The Ohio State University, USA	2001
Hancz, Erika	University of Szeged, Hungary	2000
Horn, Sherman	The Ohio State University, USA	2002
Horobik, Heather	Albion College, USA	2005
Jadoo, Hardai S.	University of Florida, USA	2002

Student	College or University	Year
Jozefow-Czerwinska, Bozenka	Jagiellonian University, Poland	2003
King, Ellen	The Ohio State University, USA	2001
Kompanek, James H.	University of Pittsburgh, USA	2001
Kurgan, Kathleen	Penn State University, USA	2003
Lanci, Noel P.	University of Kansas, USA	2002
Lane, Molly	The Ohio State University, USA	2006
LeDuc, Matthew	University of Michigan, USA	2005
Lee, Elizabeth	University of California–Berkeley, USA	2003
Lichtenstein, László	University of Szeged, Hungary	2000–2003
Löffler, Zsuzsanna	University of Szeged, Hungary	2000
Mattoon, Jocelyn	Kansas State University, USA	2005
Mccubbin, Gwyneth	Penn State University, USA	2002
Nagy, Márta	University of Szeged, Hungary	2000
Nathan, Smiti	George Washington University, USA	2006
Neff, Margaret	University of Arizona, USA	2006
Osztás, Anett	University of Szeged, Hungary	2000
Pál, Róbert	University of Szeged, Hungary	2000
Parsons, Timothy A.	Millsaps College, USA	2001
Patel, Nisha	The Ohio State University, USA	2001
Plueard, Jessie	Southern Oregon University, USA	2003
Purdin, Bethany J.	Florida State University, USA	2002
Reynolds, Sean	Florida State University, USA	2006
Roberts, Tim	Florida State University, USA	2003
Roos, Christopher	University of Arizona, USA	2000
Sauer, Erin	The Ohio State University, USA	2005
Schiszik, Lauren	Earlham College, USA	2005
Shum, Annalee	Florida State University, USA	2006
Smith, Abigail	Rice University, USA	2006
Sonnenborn, David	Columbia University, USA	2003
Spasic, Milos	University of Belgrade, Serbia	2005
Strand, Katherine	University of Wyoming, USA	2006
Swafford, Amber M.	Kansas State University, USA	2001
Szegedi, Éva	University of Szeged, Hungary	2002–2005
Szolnoki, László	Eötvös Loránd University, Hungary	2000
Tate, Robert R.	The Ohio State University, USA	2002
Tebben, Alex	The Ohio State University, USA	2005
Vidale, Juan	University of Cincinnati, USA	2006
Warner, Walter	Florida State University, USA	2005
Weinstein, Mara	The Ohio State University, USA	2005

and book chapters. The graduate schools where Körös Regional Archaeological Project participants continued their education and development as young scientists in anthropology or related fields include the University of Arizona, University of Chicago, University of Florida, Florida State University, University of Georgia, University of Illinois at Chicago, Institute of Archaeology–London, Kent State University, University of Michigan, University of New Mexico, The Ohio State University, University of Pittsburgh, SUNY Buffalo, Tulane University, Washington University (Saint Louis), University of Washington, University of Wisconsin, and University of Wyoming.

Organization of the Book

The book is divided into six parts. In this introductory chapter, we summarized the goals, scope, and analytical framework of the Körös Regional Archaeological Project. We reviewed previous archaeological research in the Körös region and related our research to those earlier

Table 1.4. Volunteers, specialists, experts, and other participants on the project, 1998–2006

Name	Affiliation
Bácsmegi, Gábor	Munkácsy Mihály Museum, Hungary
Bartosiewicz, László	Eötvös Loránd University, Hungary; Stockholm University, Sweden
Bóka, Gergely	Várkapitányság Ltd., Hungary
Choyke, Alice M.	Central European University, Austria
Domokos, Tamás	Retired, Hungary
Doran, Barrett	Utah, USA
Duffy, Paul R.	Christian-Albrechts University of Kiel
Duwe, Samuel G.	University of Oklahoma, USA
Fogas, Ottó	Móra Ferenc Museum, Hungary
Fowles, Severin	Barnard College, USA
Frolking, Tod A.	Denison University, USA
Gábor, Gabriella	Retired, Hungary
Galaty, Michael L.	University of Michigan, USA
Giblin, Julia	Quinnipiac University, USA
Harrower, Michael	Johns Hopkins University, USA
Hegedűs, Katalin	Deceased, Hungary and USA
Hoekman-Sites, Hanneke	Florida, USA
Horváth, Ferenc	Retired, Hungary
Hughes, Michelle	Santa Rosa Junior College, USA
Kasper, Kimberly	Rhodes College, USA
Kékegyi, Dorottya	Hungary
Kovács, Zsófia Eszter	Independent researcher, Hungary
Makkay, János	Retired, Hungary
Marton, Tibor	Institute of Archaeology, Research Center for the Humanities, Hungary
Michelaki, Kostalena	Arizona State University, USA
Morris Downing, Margaret	The Ohio State University, USA
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Nicodemus, Amy	University of Wisconsin–La Crosse, USA
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Name	Affiliation
Parsons, Timothy A.	Florida Department of State, National Park Service, USA
Petrovszki, Zoltán	Munkácsy Mihály Museum, Hungary
Pugh, Daniel	Nazarbayev University, Kazakhstan
Raczky, Pál	Eötvös Loránd University, Hungary
Reichert, Richard	Farley Zuber Foundation, USA
Royce, Karen	The Ohio State University, USA
Salisbury, Roderick B.	University of Vienna, Austria
Sarris, Apostolos	Institute for Mediterranean Studies, FORTH, Greece; University of Cyprus, Cyprus
Sebők, Katalin	Eötvös Loránd University, Hungary
Shum, Annalee	Florida State University, USA
Sosna, Daniel	Florida State University, USA
Starnini, Elizabeth	University of Pisa, Italy
Sümegi, Pál	University of Szeged, Hungary
Torma, Andrea	University of Szeged, Hungary
Tószögi, György	Hungary
Tóth, Zsuzsanna	Eötvös Loránd University, Hungary
Waggoner, Jamie	Deceased, USA
Walter Gagliano, Dawn	ASC Group, Inc. Ohio, USA

results. We also presented a brief history of our own field investigations from 1998 until 2007 and discussed how we have integrated teaching and research in our investigations. Table 1.4 lists the volunteers, experts, and specialists who have participated on the project.

In Part II, we discuss the results of our regional investigations, including paleohydrological and paleoenvironmental reconstructions and geophysical, geochemical, and archaeological surveys. This work begins with Chapter 2, where Tod Frolking presents the results of paleoenvironmental and geomorphological investigations near the Vésztő-Bikeri and Körösladány-Bikeri sites, at the Vésztő-Mágor tell, and in the ancient channels of the Sebes-Körös River. In Chapter 3, Attila Gyucha and Paul Duffy use multiple GIS datasets (aerial photos, modern topography, soil types, historic Habsburg military survey maps, and the results of the MRT surveys) to refine the reconstruction of the Holocene paleohydrology of the Körös region. Methods and results of archaeological surface collections at several Early Copper Age sites are presented and discussed by Richard Yerkes, William Parkinson, and Attila Gyucha in Chapter 4. The results of soil chemistry studies in the Körös region are summarized by Meredith Hardy, Michael Galaty, Roderick Salisbury, and Doc Billingsley in Chapter 5. In Chapter 6, Apostolos Sarris presents the results of geophysical surveys at three Early Copper Age sites, Vésztő-Bikeri, Körösladány-Bikeri, and Okány-Futás, and at the multicomponent Vésztő-Mágor tell.

Part III includes summaries and discussions of our excavation, data collection, and recording methods in Chapter 7 by Richard Yerkes, William Parkinson, Attila Gyucha, and Margaret Morris Downing. In Chapter 8, reconstructions of the stratigraphy, layout, and chronology of each of the two excavated Early Copper Age villages are discussed by Attila Gyucha, Richard Yerkes, and William Parkinson.

Part IV contains the results of studies of materials from the Vésztő-Bikeri and Körösladány-Bikeri sites. The results of typological, stylistic, and functional analysis of ceramics from the two Early Copper Age sites are summarized by Attila Gyucha and William Parkinson in Chapter 9. In Chapter 10, Samuel Duwe, Timothy Parsons, Michael Galaty, and Hanneke Hoekman-Sites present the results of their elemental, mineralogical, and petrographic analyses of ceramics and daub samples. Bone and antler artifacts are described and discussed by Zsuzsanna Tóth, Alice Choyke, and Attila Gyucha in Chapter 11. Chipped stone artifacts are discussed in Chapter 12 by William Parkinson and Tibor Marton.

Other small finds are described by Attila Gyucha and István Oláh in Chapter 13. Faunal assemblages from the Vésztő-Bikeri and Körösladány-Bikeri sites are analyzed and discussed by Amy Nicodemus, Zsófia Eszter Kovács, and Richard Yerkes in Chapter 14. In Chapter 15, Richard Yerkes, Attila Gyucha, and Kimberly Kasper describe floral assemblages from the two sites. Julia Giblin and Michelle Hughes Markovics discuss the human remains from Vésztő-Bikeri and Körösladány-Bikeri in Chapter 16.

Part V includes Chapter 17, the concluding chapter, by William Parkinson, Attila Gyucha, and Richard Yerkes. It places the results of our research at the Copper Age Bikeri sites into the broader context of the Körös region, the Great Hungarian Plain, the Carpathian Basin, and southeastern Europe.

Part II

Regional Investigations in the Körös River Drainage

Chapter 2

Landscapes and Soils in the Study Area

Tod A. Frolking

The amenable climate, deep soils, and flat terrain of the eastern portion of the Great Hungarian Plain provide bountiful harvests using modern agricultural technologies. The productivity of the land depends on the careful management of water as the area is subject to both flood and drought. On the very flat lower (Hungarian) portion of the Körös River system in the study area (Figure 2.1), the fine textured soils on what at first glance is a featureless plain promoted frequent seasonal flooding prior to the extensive river regulation projects of the Habsburg period (see Chapter 3, this volume). From a prehistoric perspective, the widespread modification of the region's drainage and the subsequent widespread plowing as agricultural production intensified have obscured, and in many cases erased, the evidence of earlier, less intensive uses of the plain. This chapter is an examination of the landscape's natural history that predates extensive human modification of the terrain.

The Bikeri area in the lower Körös Basin has inherited many terrain features from the late Weichselian period of the last glaciation, including thick deposits of fine-textured infusion loess reworked by surface water and paleochannels on an aggrading landscape. This is a terrain with very low local relief (from 1 to 3 m) and a low regional slope (from 0.05 to 0.07 m/km). Basin depositional rates, which averaged 20 cm per 1,000 years through the mid- to late Pleistocene and were certainly much greater during the last glacial maximum, decreased to almost nil during the Holocene. The fine-grained, generally well-drained steppe solonetz (*sztyeppesedő réti szolonyec*) and poorly drained meadow clay (*réti talaj*) soils of the Bikeri area appear to have been quite stable during the Early Copper Age, when the Vésztő-Bikeri and Körösladány-Bikeri villages were occupied.

Geomorphological studies were directed at providing a landscape context for the Körös Regional Archaeological Project. A primary goal was to understand land-use practices in the study area during the Late Neolithic–Early Copper Age transition (e.g., Gyucha et al. 2004, 2009, 2014; Parkinson et al. 2002, 2004a, 2010b; Yerkes et al. 2007, 2009). To accomplish this, several locations near the Vésztő-Bikeri and Körösladány-Bikeri sites, west of the town of Vésztő and close to the pre-regulation channel of the Sebes-Körös River, were investigated.

The sediments, soils, and paleohydrology of the Bikeri locality reflect a landscape with exceedingly low relief, and hence low sediment transport energy and poor drainage. In this environment, slight topographic differences can have significant impacts on sediment texture and soil drainage conditions, and thus on human land-use patterns. The goal of this study was to determine the degree to which changes in environmental conditions (for example, changes in landscape and hydrology) might have encouraged or allowed the dispersal of settlements away from nucleated tells at the end of the Late Neolithic (Gyucha 2015; Gyucha et al. 2009; Parkinson 2006a; Parkinson et al. 2004a).

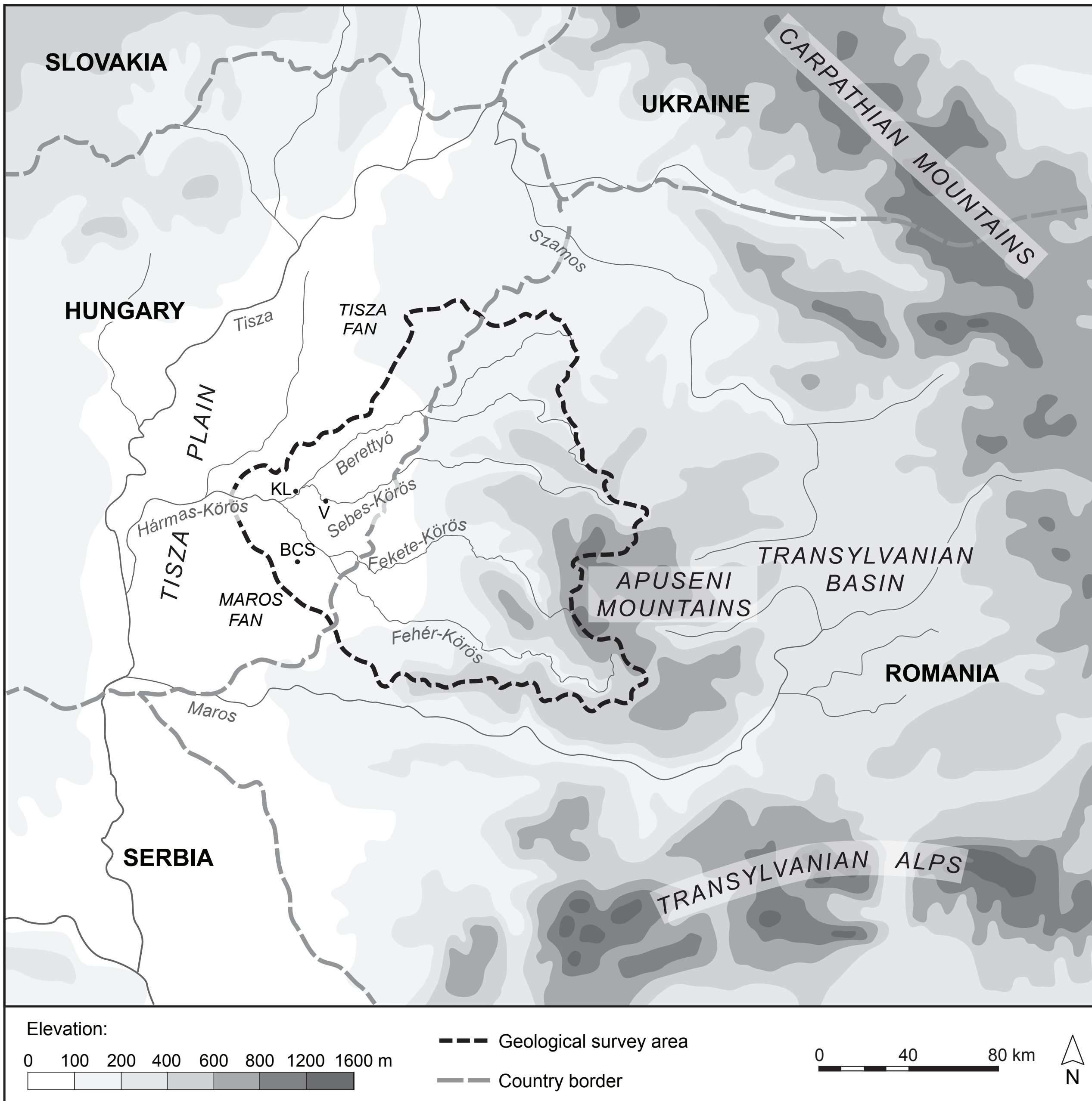


Figure 2.1. Generalized topographic map of the eastern Carpathian Basin and surrounding mountains, with elevation data from KOCRIS (2007) and László Zentai's (1996) maps. Körös River system branches (north to south) are the Berettyó, Sebes (Rapid)-Körös, Fekete (Black)-Körös, and Fehér (White)-Körös Rivers, which form the Hármas (Triple)-Körös River. Key to other cities and towns: V = Vésztő; KL = Körösladány; BCS = Békéscsaba. *Figure by Tod A. Frolking, Richard W. Yerkes, and Jill Seagard.*

Unfortunately, the results of field and lab work did not provide the temporal resolution necessary to assess environmental changes through the time period in question. Therefore, the emphasis broadened to a more general investigation of Holocene landscape evolution in the Körös River basin as revealed by its soils and hydrology. Many scholars in eastern Hungary and beyond have examined the important relationships among landforms, hydrology, settlement patterns, and cultivation activities during the Neolithic (Gillings 1995; Gyucha 2015; Kosse 1979; Parkinson 2002; Sherratt 1983a). This chapter provides the strictly geomorphological and hydrological underpinnings for a more rigorous analysis of these relationships.

Following a summary of the geomorphological evolution of the Körös River basin, the terrain in the general vicinity of the Vésztő-Bikeri and Körösladány-Bikeri sites will be examined, and stream channel and floodplain characteristics of the Sebes-Körös River in the vicinity of the Vésztő-Mágor tell (located about 2 km to the north; Hegedűs and Makkay 1987) will be described. This largely local land surface study complements a broader inquiry into the links between drainage patterns and settlement patterns within the lower Körös Basin (Gyucha and Duffy 2008; Gyucha et al. 2011; see also Chapter 3, this volume).

Overview of the Körös River Basin

Geological Setting

The Körös/Crişul drainage basin is within the Great Hungarian Plain in the eastern portion of the Carpathian Basin, which also is known as the Pannonian Basin. The four main branches of the Körös River system originate in the Apuseni Mountains of northwestern Romania and flow generally westward, ultimately converging about 20 km west of Vésztő to form the Hármas (Triple)-Körös River (Figure 2.1; see also Chapter 3, this volume). At this point, the basin area is approximately 27,500 km^2 (KOCRIS 2007). The Great Hungarian Plain, and particularly the lower Körös River basin, is a region of exceptionally low relief. A brief analysis of the area's recent geological history helps explain the generally flat terrain as well as some subtle variations in regional topography.

The eastern Great Hungarian Plain has undergone subsidence and sedimentation since the middle Miocene in response to the eastward advance of the Carpathian subduction zone (Horváth 1993) and associated uplift of the Carpathian mountain arc (Royden and Horváth 1988). Following the closing of the Pannonian Sea in the late Miocene, the sedimentary deposits evolved from offshore basin sediments to transgressive delta facies in the Pliocene to alluvial facies in the early Pleistocene (Nádor et al. 2005). During the late Miocene/Pliocene phase of lacustrine sedimentation, the Körös River region received 600 to 700 m of fine-grained sediment.

Through the Pleistocene epoch, the spatial and temporal patterns of terrestrial sedimentation reflected the interplay of tectonic and climatic controls on an evolving topography. For example, buckling within the Pannonian Basin caused uplift in the Transdanubian Basin to the west and the Transylvanian Basin to the east, while eastern Hungary continued to subside, thus directing sedimentation toward the Körös River region (Horváth and Cloetingh 1996). The uplift of the Apuseni Mountains began during the Pliocene–Pleistocene transition and caused a shift of sediment sources for the Körös region from the northeast to the east (Nádor et al. 2005). With this uplift, a synsedimentary trap formed west of the Apuseni Mountains in the vicinity of the present Romanian–Hungarian border. This depression focused the deposition of coarser fluvial sediment to the east of the axis in modern Romania, with finer deposits extending west into eastern Hungary.

In addition to this east–west sedimentation gradient, there were significant north–south variations in rates of Pleistocene subsidence and sediment accumulation in eastern Hungary (Franyó 1992). Broad, low-gradient, largely loess-mantled, late Pleistocene glaciofluvial fans formed by the late glacial paleo-Tisza/Szamos River drainage to the north and the Maros River drainage to the south bound the Körös Basin in eastern Hungary (Figure 2.1). These river systems are both significantly larger than the Körös/Crişul River. They head well to the east in the somewhat higher terrain of the northeastern Carpathians of Ukraine and the Carpathians of eastern Romania, respectively. The higher elevations of the Tisza and Maros fan surfaces relative to the Körös plain are likely due in part to the higher sediment loads of these larger river systems. Sediment texture also may play a role, as the finer Körös River sediment would likely undergo greater compaction than the coarser fan material to the north and south, thus leading to lower surface elevations through time. The current axis of the Tisza River no longer aligns with its former fan surface. During the late Pleistocene, the Tisza River entered the Great Hungarian Plain from a point south of the higher terrain of the Nyírség in Northeast Hungary, with its main focus of deposition along what is now the Berettyó Valley. During the early Holocene, its course shifted to the north of the Nyírség, and it currently enters the Great Hungarian Plain at the Tokaj Gate (Pécsi and Sárfalvi 1964).

The relatively low elevation of the modern Körös plain also reflects structural controls. The Körös River basin has been a region of focused subsidence, with up to 600 m of largely fluvial, fine-grained sediment accumulating during the Pleistocene (Cooke et al. 1979; Thamó-Bozsó et al. 2002). The axis of an east-west-trending depocenter extends from Vésztő west to the confluence of the Körös River branches (Juhász et al. 2004). Along with a depocenter in the Tisza–Körös confluence area to the west, this area has the thickest Pleistocene deposits on the Great Hungarian Plain. At Vésztő, a deep borehole reveals about 150 m of post–Brunhes/Matuyama reversal (circa 730,000 BP) sediment, for an average subsidence and sedimentation rate of 20 cm/ky. Regional borehole records reveal generally fining-upward facies associations of 40–100 m in thickness (Juhász et al. 2004). In the middle to late Pleistocene, these packages show a 100 ka cyclicity that is consistent with global paleoclimatic records (Thamó-Bozsó et al. 2002). The degree to which these cycles reflect variable subsidence rates, and hence available sediment accumulation space or variations in sediment flux linked to climatic changes, remains an open question (Juhász et al. 2004).

In a study of depositional facies within the Körös River basin, Juhász et al. (2004) differentiated five sedimentary packages: (1) sandy channel deposits that typically can be identified by a well-defined base; (2) fining-upward point bar deposits; (3) fine-grained floodplain deposits that are probably laterally extensive; (4) thinner sandy-silty beds comprising combinations of levee, crevasse splay, and aeolian deposits; and (5) distal fan deposits in the eastern part of the basin that consist of sandy sheet-flood deposits interbedded with muddy deposits. The locations of the tributaries that comprise the Körös River system appear to have been fairly fixed in space through at least the mid- to late Pleistocene. Borehole and water well data indicated that the coarse-grained channel deposits occur in vertical sequences in the general locations of the modern tributaries (Mike 1991). This pattern would suggest that away from these channel sequences there has been significant overbank deposition in long-term backswamp areas rather than aggradation by channel avulsions and consequent shifts of focused near-channel sedimentation.

The sedimentological interpretation of Juhász et al. (2004), as noted above, assumes that the basin was dominated by low-energy meandering rivers through most of the depositional sequence. It does not recognize possible shifts in the character of fluvial activity with climate fluctuations during the Pleistocene, for example, between periods dominated by meandering and by braided channels. Many studies have noted dramatic changes in stream activity during the Weichselian as well as during the shift from periglacial conditions to temperate conditions during the late Weichselian–Holocene transition (Mol et al. 2000; Vandenberghe 1995).

Mike (1991) recognized little Holocene fill across both the Körös and Maros Basins, attributing the bulk of the sedimentation to the late Pleistocene. This conclusion is supported by preliminary data from Nádor et al. (2005). Based primarily on aerial photo interpretation of a 4,000 km^2 swath centered on the lower Körös River system, they divided their study area into three east–west zones. In the north, along the Berettyó River axis, large, well-developed meanders are present on an 87 masl surface, the central section consists of a complex of small meandering channels with anabranching characteristics at 85 to 86 masl, and in the south a braided pattern can be seen at 88 to 89 masl. Preliminary optically stimulated luminescence (OSL) dating indicates that in the northern zone, sand at depths between 1.7 and 4 m was deposited around 25,000 to 40,000 years ago and that sediment at depths between 0.6 and 1.1 m in the southern braided section dates from about 39,000 to 50,000 years ago.

Nádor et al. (2005) go on to suggest a temporal fluvial sequence from braided channels to meandering channels to tight anabranching channels, with the drop in elevations explained by tectonic subsidence. This interpretation seems to assume a temporal shift in focus of fluvial deposition from south to north to central, controlled in part by tectonic subsidence while apparently ignoring the activities of three different river systems, the paleo-Tisza River in the north, the Körös River, and the Maros River in the south, which could help explain the three different channel regimes.

Late Quaternary Evolution of the Körös River Terrain

Due to a combination of a lower sediment flux and a greater rate of subsidence during the late Quaternary (Juhász et al. 2004), the Hungarian portion of the Körös Basin lies 5–10 m below the adjacent Tisza and Maros Fans. Therefore, the Körös River branches have relatively low regional gradients in their lower sections—that is, from the Romanian border to the confluence with the Tisza River, some 70 to 110 km downstream. Upstream, the Körös River branches originate in the Apuseni Mountains, 80 to 150 km east of the border between Hungary and Romania (Figure 2.1; see also Chapter 3, this volume). Based on a generalized digital elevation model for the Körös Basin (KOCRIS 2007), the upland valley floors widen and the river channels become clearly alluvial at elevations of approximately 250 to 300 masl. In downstream sections, descending from elevations of 250 masl to 150 masl in the upper alluvial section, mean valley floor gradients range from a low of 2.2 m/km to a high of 3.1 m/km for the Sebes (Rapid)-Körös River (Crişul Repede in Romanian). With higher gradients in this section, the name “Rapid” Körös may not be inappropriate. Farther downstream, the valley floor gradients diminish significantly as the valley floors merge with the eastern portion of the Great Hungarian Plain in western Romania. The eastern margin of this open plain lies at an elevation of approximately 100 masl. In descending from 100 to 85 masl across the plain, straight-line floodplain gradients range from about 0.30 to 0.50 m/km, a six- to eight-fold decrease from the sections above 150 masl. This decrease in slope should significantly impact both stream hydrology and sediment transport capacity for the channels in easternmost Hungary.

At the Hungarian border, the Sebes-Körös plain lies at about 95 masl, whereas the Fehér (White)-Körös and Fekete (Black)-Körös branches lie at or below 85 masl. Prior to river regulation, the northern and southern Körös River branches joined near present-day Köröstarcsa to form the Hármas-Körös River, which meanders westward to meet the Tisza River at an elevation of 80 masl near Csongrád, about 80 km west of the study area (Figure 2.1). In its lower reaches, the Körös River system has a regional slope of only 0.05 to 0.06 m/km. This gradient is similar to that of the larger, south-flowing Tisza River in the 150 km section upstream from the rivers' confluence. The very low regional gradients of the lower Körös River and middle Tisza River would retard water flow through their basins and thus would promote flooding and limit the subsequent drainage of floodwaters. The probable pre-regulation flood regime along the lower Sebes-Körös will be discussed below.

Given the very low regional slope, it is not surprising that much of the Körös Basin in easternmost Hungary—the area of the Nagy-Sárrét (Great Mud Meadow) and Kis-Sárrét (Little Mud Meadow)—consists of low-lying, poorly drained floodplain/backswamp terrain with a tangle of discontinuous, sinuous channel and levee-like features (Pécsi 1970; Sherratt 1983a; see also Chapter 3, this volume). Numerous sets of weakly expressed meander scars and levees imply that channel avulsion was a dominant mechanism of drainage adjustment during at least the later phase of basin aggradation. Both the planimetric Habsburg military survey maps of the early to mid-1800s and modern topographic maps indicate that the streams had low-gradient, highly sinuous channels prior to widespread canalization in the 1800s (Gyucha et al. 2011; see also Chapter 3, this volume).

Two water well logs at Vésztő revealed 10–15 m of silty clay overlying variable silty clay and silty sand units to depths exceeding 60 m. Following the descriptions of Juhász et al. (2004), these sediments appear to conform to the fine-grained floodplain deposit facies and the thinly bedded sandy/silty facies that may indicate channel levees, avulsion deposits, and aeolian deposits. Local pedologists speak of "wet loess" or "infusion loess," suggesting that much of the upper sediment derives from aeolian deposition into a seasonally wet environment. In this study, numerous shallow cores (typically 2–4 m deep) consisted of mainly silty sediment with irregularly spaced, thin (2–10 mm) lenses or zones of visibly coarser silt to very fine sand. This irregular sorting suggests aeolian deposition, with occasional reworking by slow-flowing water. Chronological studies from classic loess sequences in central Hungary indicate that the bulk of the younger loess deposit (Weichselian) occurred from about 20,000 to 13,000 BP, with little deposition during the subsequent stable, soil-forming Holocene period (Frechen et al. 1997).

Holocene modifications of the terrain would thus be restricted to hill slope and fluvial activity. Given the slow rates of slope activity in the very flat terrain in the Körös Basin, a major focus of this chapter concerns stream activity. The rates of stream channel migration and/or avulsion and the rates of basin sedimentation during the post-glacial period and particularly during the middle Holocene are of central importance to this study and to broader archaeological research in the region. Prehistoric fluvial activity would impact the distribution and stability of habitation sites as well as the depth of burial of features and artifacts. In a subsequent section, the channel activity and pattern of sedimentation for a short stretch of the Sebes-Körös River near the Early Copper Age Vésztő-Bikeri and Körösladány-Bikeri villages will be examined.

Environmental Conditions during the Mid-Holocene

There are no published pollen profiles that provide details about the local environmental conditions of the Bikeri area during the Late Neolithic and the Early Copper Age (circa 5000–4000 cal BC). Even though soils in the area were poorly drained and numerous historical accounts describe marshy conditions, the general flatness of the land provides few depressions that would remain perennially saturated and offer sufficient depth to allow organic matter accumulation through a significant time period. Abandoned channel meanders, or oxbow lakes, likely would provide the most suitable depressions for pollen deposition and peat accumulation.

Pollen profiles have been studied 70 km northwest of the study area in a meander loop of the middle Tisza River near Tiszapüspöki, but the relative impacts of climate and anthropogenic influences on the mid-Holocene sequence have not been resolved, and the author cannot discount long-distance fluvial mixing of pollen grains (Sümegi 2004). Pollen records in Northeast Hungary indicate broadleaf deciduous forests with fluctuations in the abundance of *Corylus* and *Carpinus betulus* related to Neolithic and Copper Age forest use (Gardner 2002; Magyari et al. 2012). A study of pollen sites in the Carpathians to the southeast in Romania (Rösch and Fischer 2000) supports

Gyulai's (1993) earlier regional synthesis, which indicates a dominance of mixed oak forest during the Atlantic phase (circa 6000–3000 cal BC), with beech/oak forests and some parkland steppe during the cooler early Subboreal phase (circa 3000–2500 cal BC). Some authors suggest widespread parkland/steppe in the Körös Basin with gallery forests along watercourses (Pécsi and Jakucs 1971).

Willis (2007) published a core from the Kiri-tó (Lake Kiri), an oxbow that formed along the Berettyó River near Ecsegfalva at the edge of the study area (about 35 km northwest of the Bikeri sites) in the late Pleistocene. She recognized a decline in tree pollen (especially oak and hazel) around 4600 cal BC, with a corresponding increase in pollen from grasses and other open-ground plants, including cereals (Willis 2007:90). This reversed a trend of increasing pollen from broad-leaved trees that had begun about 6200 cal BC. The decline in tree pollen is associated with an increase in charcoal and total organic nitrogen in the core, suggesting significant human impact on the landscape. However, this trend was short-lived. Between 3900 and 3700 cal BC, tree pollen again increased and open-ground plants decreased, showing that the woodlands recovered at the end of the Early Copper Age (Willis 2007:97).

The reduction in woodlands near the Kiri-tó at the beginning of the Early Copper Age may be a cultural response to climate change. It may have resulted from the widespread dispersal of settlements and hence more tree felling over a larger forest area at that time, or it may be due to the establishment of a new Copper Age system of land use where more trees were felled for fields, pastures, and groves (Gardner 2002). However, since the decline in tree pollen is a local phenomenon, it appears that it was probably the result of anthropogenic processes rather than the effects of a more general climate change (Gardner 2002; Parkinson et al. 2010b; Sümegi 2004; Willis 2007).

Fluvial responses to changes in environmental conditions depend on the sensitivity of the river system to perturbations and the amount of environmental change. For example, large-amplitude paleomeanders have been noted across central Europe (Kalicki 1996). These larger channels are generally attributed to larger discharges caused by higher effective precipitation under the cooler

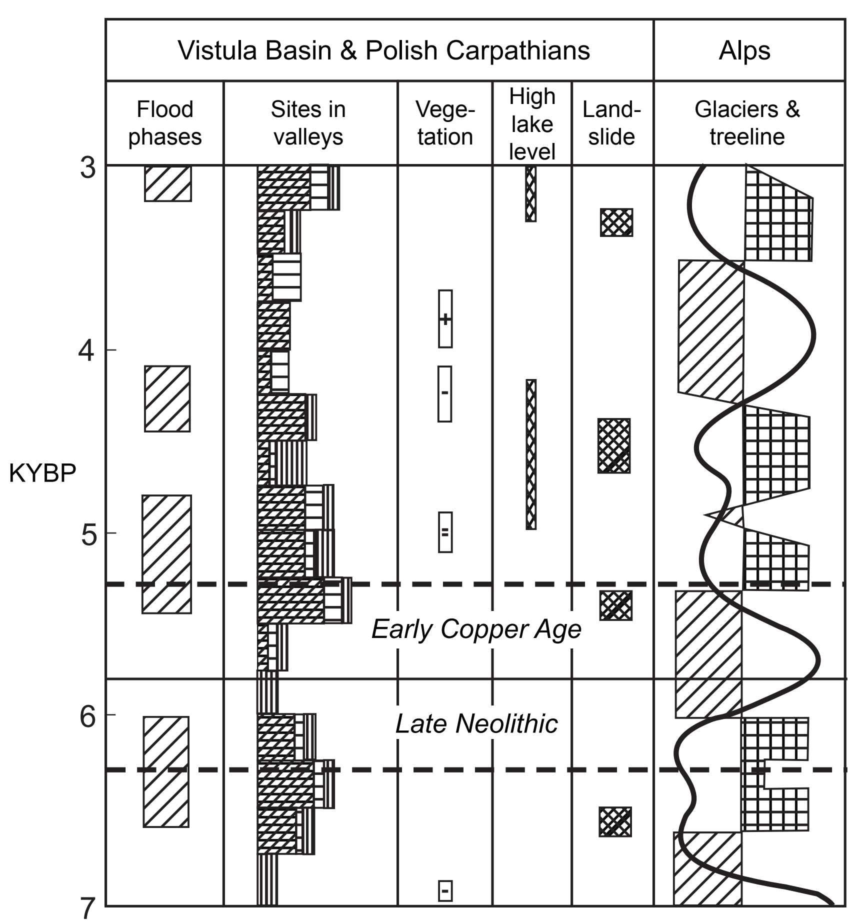


Figure 2.2. Field studies of river behavior, slope activity, vegetation, hydrology, and glacier terminus positions in the upper Vistula Basin, the Polish Carpathians, and the Alps. Dates in radiocarbon years before present (modified from Starkel 1995). *Figure by Tod A. Frolking and Jill Seagard.*

periglacial conditions of the Weichselian–Holocene transition. In some cases, permafrost may have inhibited percolation and thus promoted overland flow and relatively large, channel-forming flood discharges during summer. Clearly, the dramatic changes of the Weichselian–Holocene transition could fundamentally change patterns of fluvial activity (Mol et al. 2000).

The smaller environmental fluctuations within the Holocene leave a less clear fluvial imprint. Data from southern Romania and Poland suggest that Holocene environmental fluctuations significantly impacted fluvial systems in terms of incision/aggradation, flood frequencies, and periods of active channel migration (Howard et al. 2004; Starkel et al. 2006). Starkel's (1995) regional synthesis of slope, fluvial, and lacustrine activity in the upper Vistula Basin, the Polish Carpathians, and the Alps through the middle Holocene indicates somewhat drier conditions during the Late Neolithic–Early Copper Age transition, but no significant change in fluvial activity (Figure 2.2). Starkel (1997) reviewed a wide range of botanical, hydrological, and geomorphological changes that reflect cooler and wetter conditions in central Europe from the Atlantic–Subboreal transition, around 5000 BP. This climatic shift may have impacted the viability of low-lying settlements within the generally poorly drained lower Körös Basin, but postdates the period in question. No regional studies to date suggest a significant shift in fluvial activity through the Late Neolithic–Early Copper Age transition (Gyucha et al. 2011).

Overview of Soils in the Lower Körös River Basin

The soils of the Vésztő micro-region fall into the chernozem (well-drained prairie soils with thick A horizons), solonetz (salt-affected soils), and hydromorphic (poorly drained with prominent redox features in the subsoil) soil groups. The Hungarian Soil Classification System (HSCS) is a genetic system developed in the 1960s based on the principles established by the Russian soil scientist V. V. Dokuchaev (Micheli et al. 2006). For this study, broad soil patterns were examined on the Vésztő and Mezőtúr 1:100,000 soil maps. On these relatively small-scale maps, the two soil bodies surrounding the Bikeri sites are agricultural steppe solonetz (*sztyeppesedő réti szolonyec*) that occurs on the generally higher, modestly sloping, somewhat better-drained terrain and meadow soils (*réti talajok*) that dominate the broad flats and depressions. These and related soils of the area have silty clay loess parent material. The clay fractions are dominated by smectitic 2:1 expansible clays with lesser amounts of illite, vermiculite, kalonite, and various intergrades. The high smectite content, and hence high shrink–swell capacity, of these clay-rich soils causes them to expand and become almost impermeable when wet and to shrink and form deep mudcracks during summer dry periods. The potential impact of this shrink–swell dynamic on the region's hydrology will be discussed below.

Somewhat coarser-textured, silty, glacio-alluvial, wet meadow soils are mapped on the flats flanking the Sebes-Körös River in the east, near the Romanian border. Silty chernozems occur on the well-drained flats south of Mezőberény and Gyomaendrőd, about 20 to 40 km west–southwest of the Bikeri area. There are scattered bodies of other fine silty clay soils mapped throughout the region. The 1:100,000 soil maps are necessarily quite general, and while they provide a reasonable overview of the region's parent materials, they cannot be used to delineate subtle differences in soil texture that may be present locally (see Gyucha et al. 2011).

Field Investigations at the Bikeri sites and Vésztő-Mágor

The author first joined the Körös Regional Archaeological Project during the 2001 field season in Hungary. With the help of students and graduate assistants from the project, soils and sediments in the immediate vicinity of the Vésztő-Bikeri site were cored in late June and early July 2001. In addition, several unsuccessful forays were conducted in search of paleochannel remnants with peat deposits to the east of Vésztő. The following year, a systematic coring campaign was carried out under very dry conditions in late June and early July. During that period: (1) additional surfaces surrounding the Vésztő-Bikeri and Körösladány-Bikeri sites were cored to better characterize local stratigraphic and pedological relationships; and (2) the abandoned channel meanders adjacent to the floodplain of the Sebes-Körös in the vicinity of Vésztő-Mágor were cored to establish pre-canalization channel morphology and floodplain stratigraphy (Figures 2.3–2.4). A total of 168 samples were taken from 33 coring sites.

In July 2005, exceptionally wet conditions prevented access to many floodplain and channel sites during the first week of fieldwork. Subsequently, several paleomeander channels and adjacent floodplain surfaces of the Sebes-Körös and Hármas-Körös were examined and cored along a 60 km section upstream to Zsadány and downstream to Gyomaendrőd. A total of 69 samples were taken from 15 coring sites. Particle-size analyses for a sequence of cores taken across the first abandoned meander to the west of Körösladány are included in Appendix I.

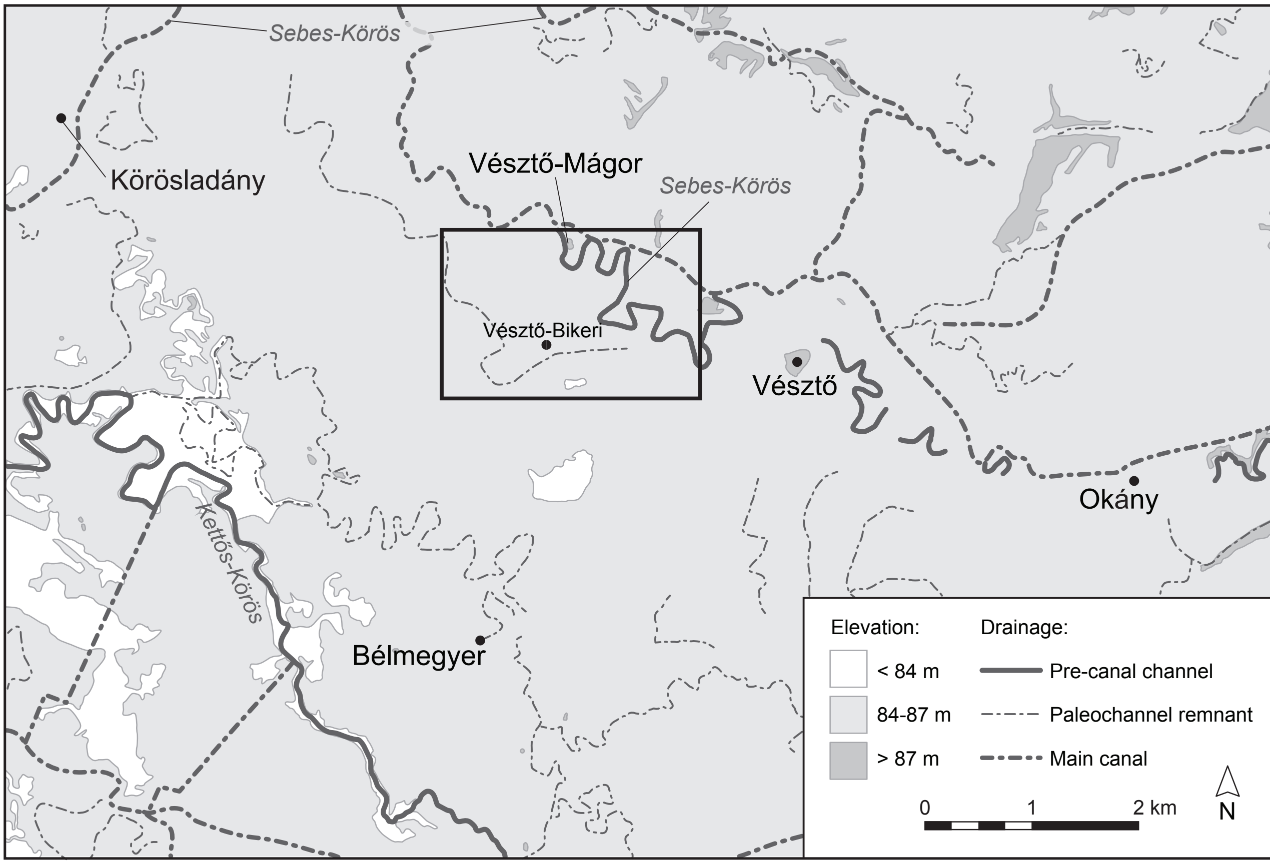


Figure 2.3. Simplified topographic and hydrological map of the Vésztő area. Area of coverage for Figure 2.4 indicated by the rectangle. *Figure by Tod A. Frolking and Jill Seagard.*

Field and Lab Methods

Continuous 1.8 cm-diameter cores of soil and sediment were extracted with an Oakfield hand coring tool. Many of the more cohesive silty clay profiles required vigorous pounding with an impact hammer to penetrate into the subsoil. In the vicinity of the Vésztő-Mágor tell, Sebes-Körös River channel deposits extended to depths of 3.5 to 4 m below the floodplain surface. Therefore, when possible, floodplain cores were taken to depths of about 4.5 m. Most sites situated on rises and flats, where no significant subsurface stratigraphic boundary was apparent, were cored to about 3 m. In some cases, the high resistance of the sediment prevented coring to the desired depth.

Hand coring, while allowing for mobility and sampling of a relatively large number of sites, severely limits the observation of structures and boundary conditions of soils and sediments. Based on coring, soil profile differences and sedimentary structures appear to be quite subtle in this low-relief landscape of fine-textured sediments. Nonetheless, test trenches at selected locations undoubtedly would provide many more insights into the evolution of the soils and terrain.

The locations of core sites near the Vésztő-Bikeri and Körösladány-Bikeri sites were recorded using a total station. At locations outside the immediate vicinity of the two Early Copper Age settlements, a handheld GPS unit, 1:10,000 topographic maps, surveying tapes, and hand levels were used to plot the coring sites. Soil properties of the core samples include color, mottling, texture, apparent sedimentary boundaries, and special features, such as carbonate concretions and laminations. All reported soil and sediment colors were taken moist using a Munsell soil color chart. Typically, 10 to 15 cm core sections from key soil horizons and stratigraphic layers were sampled for particle-size analysis (Appendix I). For subsoil sections, these 10 to 15 cm core samples did not allow for differentiation of coarser laminations and the finer bulk sediment. Subsampling and particle-size analysis of separate laminations could provide additional information on the depositional environment of subsurface materials but was beyond the scope of this study and would require sampling from test trenches to adequately characterize the sediments. Samples containing significant soil organic matter or charcoal for possible ^{14}C dating were treated separately and wrapped in aluminum foil.

Particle-size analysis utilized sieves for fractions coarser than 62 µm and the pipette method for successive silt and clay fractions based on the phi scale (Gee and Bauder 1986). To promote disaggregation and to obtain size distributions of primary materials, organic-rich samples were pretreated with H_2O_2 and samples rich in secondary carbonates were treated with 1 N HCL. The median particle diameter (D_{50}) on a mass basis for each sample was determined graphically by first plotting cumulative values (percent finer than) for each successive phi measurement, then connecting successive points with straight line segments, then determining the fiftieth percentile value along the appropriate line segment, and then converting that phi value to its equivalent diameter in microns. The D_{50} parameter provides a useful indicator for comparisons of the textures of different samples but only provides an approximate mean particle size because of uncertainty concerning the distribution of particle sizes within each phi class. The following particle-size breaks were utilized: ~12φ = 0.2 µm, 9φ = 2 µm, 7φ = 8 µm, 6φ = 16 µm, 5φ = 31 µm, 4φ = 63 µm, 3φ = 125 µm, 2φ = 250 µm, 1φ = 500 µm.

Organic carbon was determined gravimetrically by collection of evolved CO_2 onto an NaOH-coated absorbent after combusting the sample in a scrubbed oxygen gas train at 950°C (Table 2.1). Calcite equivalent contents of calcareous samples were determined by CO_2 evolution using a Chittick apparatus following the methodology of Dremanis (1962). Carbon isotope ratios of charcoal fragments and soil humates were analyzed by Beta Analytic following standard procedures.

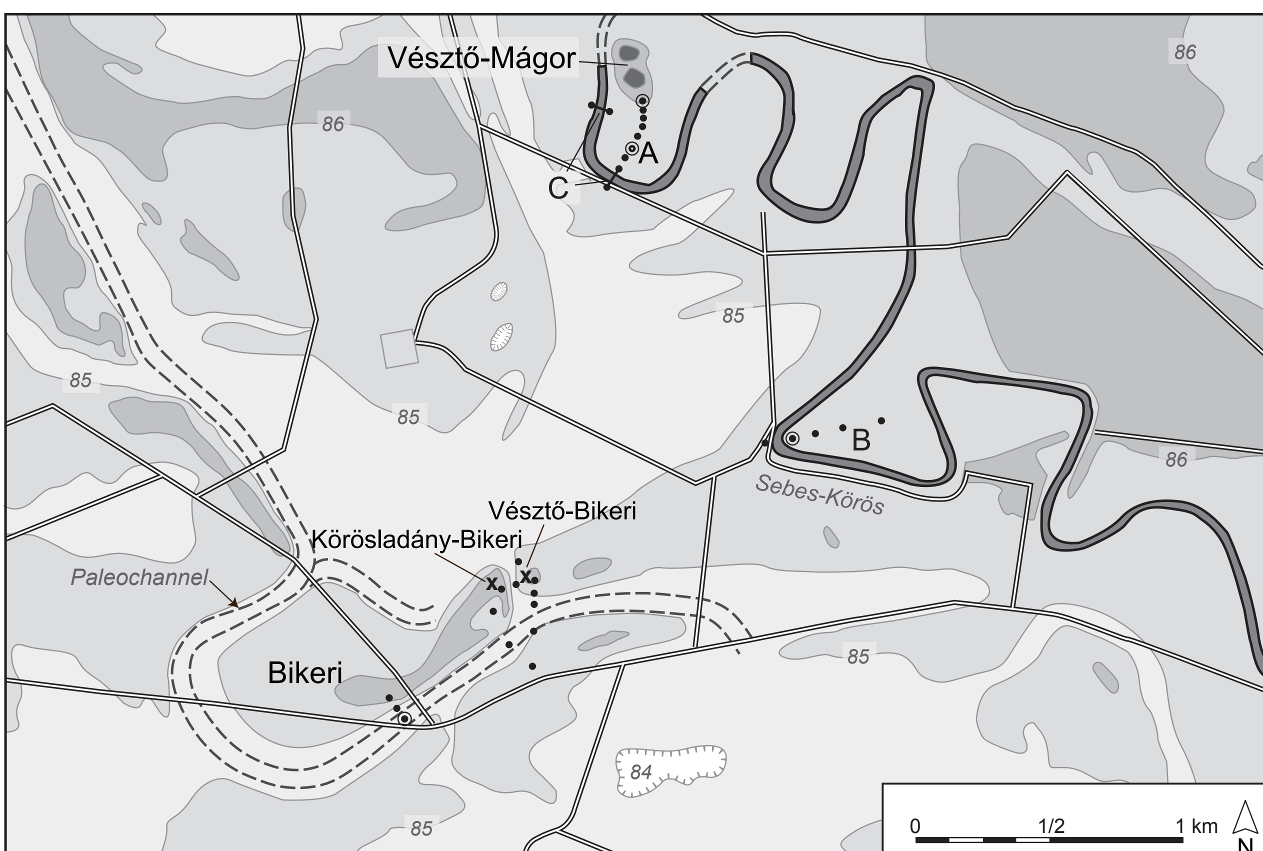


Figure 2.4. Topographic map of the study area west of the town of Vésztő showing locations of Vésztő-Bikeri, Körösladány-Bikeri, the Vésztő-Mágor tell, and analyzed soil/sediment cores. Areas cored include the topographic rises (above 86 m), topographic low, and paleochannel at Bikeri, broad flats (meadow clay soils), transects of the Vésztő-Mágor (A) and Tér András (B) *zug*s, and two channel cross-sections at Vésztő-Mágor (C). Circled dots indicate locations of radiocarbon dates. *Figure by Tod A. Frolking.*

Table 2.1. Organic carbon and calcite/dolomite analyses of selected meadow clay and overbank alluvial deposits from the Vésztő area

Sample	Dry Weight (g)	Depth (cm)	Sample/Site Description	% Org C	% Calcite	% Dolomite	CaCO3 Eqv
VE-E-4-0	36	Surface	Surface meadow clay east of Vésztő	3.16	0	0.6	0.6
BK-PC-1C-1	25	10–20	Bikeri paleochannel meadow clay	2.83	0	0.6	0.6
BK-PC-1C-2	30	50–60	Bikeri paleochannel meadow clay	1.31	0	0.4	0.4
BK-PC-1C-3	30	75–85	Bikeri paleochannel meadow clay	1.17	0	0.4	0.4
BK-PC-1C-4	33	25–35	Bikeri paleochannel meadow clay	1.79	0	0.6	0.6
MEZ-3-1	28	15–38	Mollic A loess, near Mezőtúr	2.3	7.7	2.8	10.7
VE-MA-3-1	25	23–45	Meadow clay outside Vésztő-Mágor meander	1.98	0	0.2	0.2
VE-MA-4-1	30	23–45	Alluvial A hor, 120 m inside VE-MA meander	1.6	0	0	0
VE-MA-4-2	24	51–75	Alluvial A hor, 120 m inside VE-MA meander	1.16	0	0	0
VE-MA-6-1	31	15–38	Alluvial A hor, 220 m inside VE-MA meander	1.92	0	0	0
VE-MA-6-4	32	125–150	Buried A hor, 220 m inside VE-MA meander	0.53	0	0	0
VE-MA-7-1	35	97–115	Buried A hor, 195 m inside VE-MA meander	0.73	0	0.4	0.4
VE-MA-11-1	27	15–40	Alluvial A hor, 20 m inside VE-MA meander	2.03	0	0.2	0.2
VE-FA-2-1	25	0–22	Meadow clay outside VE-FA meander	1.54	0	0.2	0.2
VE-FA-2-2	33	23–45	Meadow clay outside VE-FA meander	1.12	0	0.4	0.4
VE-FA-2-3	27	45–68	Meadow clay outside VE-FA meander	0.98	0	0.2	0.2
VE-FA-3-1	22	0–22	Alluvial A hor, 20 m inside VE-FA meander	1.65	0	0.4	0.4
VE-FA-3-2	25	23–45	Alluvial A hor, 20 m inside VE-FA meander	0.67	0	0.2	0.2

Table by Tod A. Frolking.

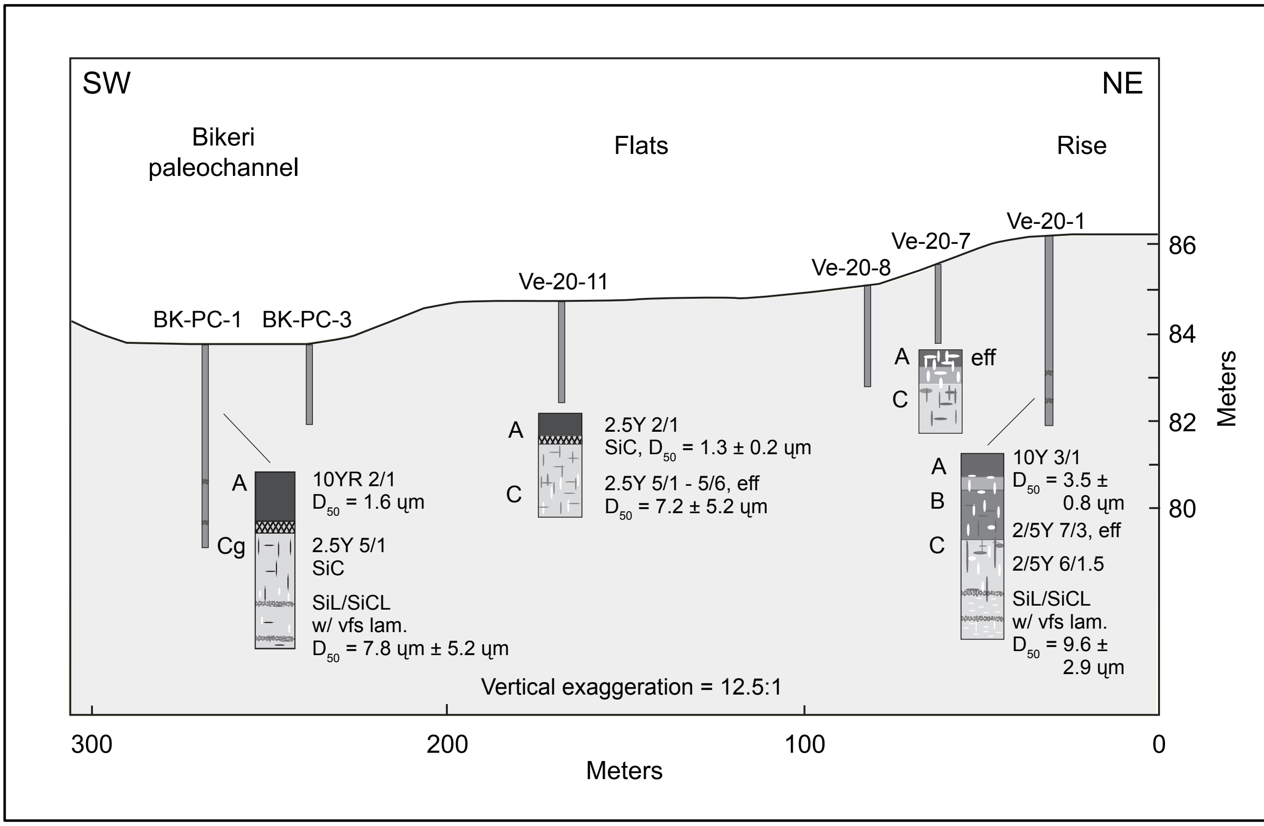


Figure 2.5. Generalized soil toposequence from the rise at the Vésztő-Bikeri site (Ve-20) to the Bikeri paleochannel illustrating key soil properties (Munsell colors, carbonate effervescence) and sediment textures along the transect. Note the substantial vertical exaggeration. SiL = silt loam; SiCL = silty clay loam; SiC = silty clay following the U.S. Soil Taxonomy (Soil Survey Staff 1975). *Figure by Tod A. Frolking and Jill Seagard.*

Results and Interpretations

A Soil Toposequence near the Bikeri Locality

At the Bikeri sites, soil/sediment cores were taken along a transect from the 86 masl rise or levee crest extending across the broad flats at 85 masl and into what appears to be a paleochannel depression at 84 masl (Figures 2.4–2.5). The goal was to better characterize landscape parent materials and to look for patterns of sediment stratigraphy that could provide insights into the landscape's geomorphological evolution. The soil toposequence reveals systematic variations in A horizon development, subsoil drainage, soil carbonate distribution, and particle-size distribution (Figure 2.5; Table 2.2).

The A horizon tends to both thicken and darken moving downslope from the well-drained crest to the somewhat poorly drained broad flats to the poorly drained depressions. Except for some areas of the poorly drained Dió Creek paleochannel near Bikeri, all sites that were examined had been plowed recently. With widespread plowing, surface horizon features, such as A horizon thickness, cannot be used to assess prehistoric slope activity. The depth to mottling decreases down the toposequence, indicating progressively poorer drainage with longer periods of saturation at shallower depths downslope. Mottles are first encountered at depths of about 100 cm on crests and at 25-40 cm on the subjacent flats. The oxidized subsoil along the crest has moist colors, from light olive brown 2.5Y 5/4 to pale yellow 2.5YR 7/3, whereas the strongly mottled and gleyed subsoils in the depressions trend toward a gray 2.5Y 5/1 matrix with yellowish-brown 10YR 5/8 mottles.

The soils have fine textures throughout their profiles, median grain size (D_{50}) ranges from 1.2 µm (coarse clay) to 12.9 µm (medium silt), with few primary grains coarser than fine sand (250 µm) in any samples. Soils on the slopes and rises have a fairly uniform, fine silty clay texture in the upper 50 to 100 cm (D_{50} = 3.4 ± 0.8 µm), whereas deeper zones tend to be somewhat coarser and show more variable texture (D_{50} = 8.2 ± 2.7 µm). The deeper zones often exhibit centimeter-scale variations

Table 2.2. Mean particle-size data for selected topographic features at Vésztő-Bikeri and Vésztő-Mágor

Landscape Position	n	% Fine Sand 0.62–0.50 mm	% Silt 2–62 mm	% Clay < 2.0 mm	D_{50} mm	Sand + Coarse Silt/ Fine Silt*	Textural Classification
Landscape rises (surface)	5	2.8 (0.6)	53.1 (4.7)	43.2 (4.1)	3.4 (0.8)	1.01 (0.09)	silty clay
Rises/flats (subsurface > 1 m)	15	2.1 (1.6)	65.0 (8.0)	32.5 (8.1)	7.7 (2.8)	1.03 (2.8)	silty clay loam
Meadow clay	7	1.0 (0.7)	46.1 (8.2)	52.8 (10.4)	1.9 (1.4)	0.58 (0.25)	silty clay
Holocene channel bed sediment	4	13.9 (17.5)	60.2 (13.8)	25.6 (7.4)	16.3 (11.6)	2.48 (1.90)	silt loam
Lateral accretion deposits	5	20.8 (10.2)	52.4 (9.3)	26.5 (2.6)	20.6 (6.2)	2.22 (0.61)	silt loam
Abandoned channel fill	5	0.6 (0.8)	45.9 (7.6)	53.2 (6.0)	2.0 (0.8)	0.59 (0.19)	silty clay

Notes: *Course silt/fine silt break at 16 mm. Values in parentheses indicate standard deviations. *Table by Tod A. Frolking.*

from silty clay to very fine sandy silt. Note that the values presented here reflect data from multiple cores, whereas the mean D_{50} values in Figure 2.5 are specific to the soil cores indicated. The greater textural variability at depth is indicated by both the larger standard deviation of D_{50} values and by greater variations in coarse silt to fine silt ratios (Table 2.2). Some of the textural variability in the deeper samples may reflect the number and thickness of coarse laminations included in different samples. These profiles follow the observations of Pécsi (1970), wherein the deeper sediments show small-scale sorting from localized remobilization that is characteristic of infusion loess. Any sedimentary laminations that would have been present in the upper portions of the profiles would likely have been destroyed by post-depositional biopedoturbation and by plowing. Therefore, the upper profiles have been texturally homogenized to some degree.

The similar coarse silt to fine silt ratios down through the profiles suggests that the apparent D_{50} fining near the surface is due to increased clay content rather than overall fining of sediment particle-size distributions. Thus it appears unlikely that the increase in clay near the surface reflects a significant shift in the character of the depositional environment through time (for example, a change in the aeolian regime or a reduction in frequency or intensity of surface water flow and therefore a greater relative deposition of fine sediment in the upper profile). Post-depositional pedogenic clay formation from the weathering of primary minerals and the breakdown of silt-size phyllosilicates would be greatest near the surface, but it does not seem likely that this alone would account for the generally higher clay content near the surface. A study of the size distributions of different minerals, both primary and secondary, through the soil profile would be needed to help resolve the genesis of the present clay distribution.

Soil profiles on rises, shoulders, and flats contain abundant secondary carbonates, often present as thin coatings on ped surfaces, but in places indurated nodules were encountered. The bulk of the secondary carbonates are calcium carbonate with minor amounts of sodium carbonate (typically less than 1 percent) in solonetz soils (T. Tóth, personal communication 2006). The high concentration of carbonates near the surface is likely due to upward migration of calcium ions in solution via capillary transport during the dry summer season. In the Bikeri area, carbonates are often present at the surface on shoulder slopes, whereas they are found at shallow depths on crests (Figure 2.5). The surface expression of carbonates on shoulders could be due to the somewhat drier soil conditions on these gently convex slopes as well as to some degree of surface erosion of shoulder positions associated with cultivation.

Meadow Clay

Meadow clay (*réti talaj*) was first examined at the Bikeri paleochannel site, where this dark brown or black, fine, dense, generally featureless, homogeneous clay was almost 1 m thick (Figure 2.5). Similar material, although typically thinner, subsequently was found on most flats and depressions in the area. The high clay content yields a strong, fine, angular blocky structure when the soil shrinks with drying. The horizon typically does not have the loose crumb structure common in the dark A horizons of coarser-textured silty chernozems (mollic epipedon in U.S. soil taxonomy). The meadow clay has considerably lower permeability when wet and perhaps greater permeability on a macro-scale when dry due to the prominent mudcracks and large interpedal voids.

From an archaeological perspective, the meadow clays appear to be significant. Many researchers have concluded that the distribution of these hydromorphic soils in the region negatively impacted or showed an inverse correlation with the intensity of land use by Mesolithic, Neolithic, and Copper Age groups (Bonsall et al. 2002; Gillings 1995; Gyucha et al. 2011; Kosse 1979; Sherratt 1983a; Sümegi 2004). People avoided meadow clay areas, undoubtedly due in no small part to their seasonally saturated conditions.

In the study area, meadow clay horizons are notably finer textured (D_{50} of 1.9 ± 1.4 µm, n = 6) than the surface horizons of soils on elevated landscapes (Table 2.2). The mean drops to a very fine 1.4 ± 0.3 µm if an anomalously coarse sample from a site on the flats east of Vésztő is removed from the group. The fine texture and low D_{50} standard deviation suggest that the meadow clay is somehow distinct from the other surface sediments. A larger sample size would help confirm or refute this observation. The mean fine clay (less than 0.2 µm) content of 27.9 ± 3.4 percent is considerably higher than for other sample groups (Appendix I). The high clay contents and the low coarse silt/fine silt ratios suggest that these horizons could not have developed in situ from the same materials that mantle the higher portions of the landscape and that also underlie the meadow clay horizons. While clay content could increase with weathering of primary minerals, it is unlikely that the silt ratios would concomitantly decrease (White et al. 1996). The higher relative surface areas of the finer silt fractions should enhance weathering and grain dissolution in those fractions, and thus the silt ratio would not likely shift with weathering. Thus the meadow clay in the Bikeri area appears to be derived from selective transport of sediment to these topographic lows.

The lack of horizonation and stratification tends to confound interpretations of meadow clay genesis. Bounding dates for alluvial/colluvial black floodplain soils (BFS) in central Germany suggest an accumulation of fine black sediment during the Boreal to Atlantic periods of the early to mid-Holocene (Rittweger 2000). Rittweger proposed that the mobilization of tightly bound clay–humus complexes could only occur following the decalcification of surface forest soil horizons as leaching proceeded during the Holocene. In Germany, the BFS horizons are often overlain by coarser deposits. This coarser material may be linked to landscape destabilization from agricultural intensification in the late Holocene. In the Körös region, both the gentle slopes and the lack of coarse-textured sediments would largely preclude such a textural coarsening of surface sediment linked to land cover change through time. Sherratt (1983a) described a site in eastern Hungary where 75 cm of meadow clay overlies Neolithic artifacts. This again indicates an aggradational or cumulic mechanism rather than simple melanization of a chernozem-like A horizon. The textural characteristics of the meadow clay encountered in this study support the conclusions of both Rittweger and Sherratt. The meadow clay material reflects a concentration of fine sediment in topographic lows.

Because no discrete pieces of charcoal or other woody material were found within meadow clay profiles, two bulk samples of the black clay were analyzed for the relative radiocarbon ages of dispersed soil organic matter in the upper and lower part of the horizon. A radiocarbon age of soil organic matter as opposed to discrete carbon fragments will typically yield a younger date than the actual age of carbon associated with sediment deposition because of the continued addition of organic material to the horizon through time (Wang et al. 1996). In the case of a meadow clay profile, uncertainties involved in the comparative ^{14}C dating at various depths are compounded by (1) differential rates of addition and breakdown of various soil organic fractions through the vertical profile; (2) potential downward leaching of soluble organic acids; (3) general biopedoturbation within the horizon; and (4) vertic mixing associated with seasonal shrink–swell and infilling of soil cracks. The large mudcracks that commonly extended to depths of 50–70 cm during dry conditions in July 2002 suggest that vertic mixing must occur. The two radiocarbon dates from the upper and lower portions of the Bikeri paleochannel meadow clay suggest accretion through the mid- to late Holocene and indicate that mixing processes have not thoroughly homogenized the profile (Table 2.3). While these dates suggest gradual clay accumulation through the Holocene, the uncertainties inherent in these dates do not allow for any quantifiable assessment of sediment accretion rate.

Given the wide distribution of meadow clay within the region, the source of this meadow clay remains an important question. In some locations, the source could be largely local and consist of fine material mobilized by rain splash and transported downslope by suspension in shallow surface flow. In other areas, there could be a largely allochthonous contribution, delivered to bottoms and flats by overbank stream flow. In Germany, Rittweger (2000) noted that the thickness of BFS deposits does not correlate

Table 2.3. Radiocarbon dating of meadow clay at Bikeri and lateral accretion deposits of Sebes-Körös meanders at Vésztő-Mágor

Sample	Landscape Position	Sediment	Material	Depth (cm)	Beta Analytic #	Calendar Years BP
BKPC-1C-1	Paleochannel depression	Meadow clay	Soil organic matter	10–20	Beta-175445	760–530
BKPC-1C-3	Paleochannel depression	Meadow clay	Soil organic matter	76–86	Beta-175446	5570–5540
Ve-Fa-3-11	Tér András-zug, 25 m inside channel	Lateral accretion, loam	Plant fiber	221–239	Beta-175447	680–630
Ve-Ma-4-5	Vésztő-Mágor-zug, 100 m inside channel	Lateral accretion, loam	Charcoal	320–343	Beta-175448	5600–5470
Ve-Ma-4-6	Vésztő-Mágor-zug, 100 m inside channel	Lateral accretion, loam	Charcoal	422–457	Beta-175449	3700–3480
Ve-Ma-10-1	Vésztő-Mágor-zug, 350 m inside channel	Lateral accretion, loam	Organic sediment	282–287	Beta-175450	8640–8460

Note: See Figure 2.4. *Table by Tod A. Frolking.*

with the size of the stream basins and hence concludes that local sources are important for BFS accretion. In the lower Körös River basin, it may well be that both local downslope transport and overbank channel delivery are important sources of meadow clay sediment, depending on the specific location. Soil developed in overbank fluvial sediment that bears a striking similarity to the Bikeri meadow clay occurs adjacent to the Sebes-Körös channel. This material is described in the next section.

In some low-lying locations that lack either an upslope or fluvial source, the meadow clay may have a coarser texture. This may be the case for the Ve-4C sample, which lies on a broad flat 10 km east of the Bikeri sites (Appendix I). Textural patterns from series of cores taken across slight swells and swales on these broad flat surfaces might help further explain the genesis of the meadow clay soil.

The Sebes-Körös River Channel at Vésztő-Mágor

Modern topographic and soil maps, as well as maps from the first military survey of the Habsburg Empire, made from 1782 to 1785 for Hungary (Gyucha et al. 2011; see also Chapter 3, this volume), indicate that prior to river regulation, the Sebes-Körös River between the towns of Vésztő and Körösladány was a slow-flowing stream in a narrow, highly sinuous, single channel bounded by cohesive silty clay bank sediments.

Some preliminary sediment cores taken in 2001 indicated only modest recent human disturbance of the old Sebes-Körös River channel and associated floodplain near the Vésztő-Mágor tell, probably due in part to its protected status in the national park. In 2002, the interior of the meander loop (*zug*), where the Vésztő-Mágor tell is located, and the interior of an upstream meander loop were systematically cored and two channel cross-sections were surveyed and cored (Figures 2.4, 2.6–2.7). This work provided information concerning channel size and activity as well as floodplain stratigraphy and sedimentology. The four distinct sedimentary packages that were encountered are discussed below (Table 2.2; Figures 2.6–2.7).

In 2005, additional meander scars and floodplain sediments were examined downstream near Körösladány and Gyomaendrőd and upstream 4 km northeast of Zsadány. Textural data for some samples from the Körösladány site are presented in Appendix I.

Meadow clay over infusion loess

The cores outside the channel meanders (core Ve-FA-2 [no PSA] at location B and core Ve-MA-3 at location C; Figure 2.4) have 60-plus cm of black meadow clay overlying silty clay with coarse silt/very fine sand laminations characteristic of infusion loess. These cores appear to show a slow rate of overbank accretion (meadow clay) with no evidence of past channel activity. At these sites, the flat floodplain surface extends away from the channel with no indication of focused levee deposition.

Lateral accretion deposits

The subsurface samples from cores inside the channel meander are significantly coarser than those outside, with D_{50} values in the medium silt range and with 9 to

32 percent fine sand (Table 2.2). Near the channel, the A horizons are thinner (20 to 30 cm) and somewhat lighter colored (10YR 3/1) than the black meadow clay present outside the channel. The A horizons tend to thicken and darken inward from the meander, suggesting a progressively older surface with more accretion of fine, organic-rich overbank sediment and more time for melanization of the A horizon. The silty/fine sandy subsoil has coarser and finer zones, typically 10 to 15 cm thick, suggesting variations in depositional conditions, but it lacks the centimeter-scale laminations found in infusion loess. The subsoil sediment appears to be a lateral accretion deposit of a low-energy channel. The sediment tends to fine upward as would be expected for point bar deposits, but the range of textures falls within the very fine sand to medium silt range throughout the profiles. Abundant secondary carbonates present in the lateral accretion deposits indicate that profile redistribution of carbonates was active during the period following deposition.

An apparently abrupt transition to a more cohesive silty zone occurred at variable depths, ranging from 380 to 450 cm in four different cores taken from the channel edge to 150 m inward on the meander loop interior (*zug*) surface. This contact and the nature of the underlying deposits were difficult to characterize given the problems in core extraction at these depths. Under saturated conditions, the overlying fine sand is prone to collapse into the core hole; hence the extraction of clean, reliable core sections is problematic. This zone appears to be a transition to non-fluvial fine-textured sediments.

Abandoned channel fill

Following channel diversions and canal construction, reaches of the former Sebes-Körös River lying outside canal floodways either would have been filled artificially or been left standing as stagnant sinuous ponds fed by local runoff and shallow groundwater flow. At Vésztő-Mágor, the former channel is partially filled with sediment that includes organics, with wetland vegetation encroaching on the central areas of open water. This partial infilling permitted hand coring of two channel cross-sections (Figures 2.6–2.7). The surficial fine sediment contained fibrous muck with abundant leaves, stems, and root mass, which graded downward to gray fine silt and clay (gley 1 4/1.5 to 2.5Y 6/1). Samples of this fine-textured channel fill have particle-size distributions quite similar to meadow clay horizons on the adjacent flats (Table 2.2). While both the channel fill and meadow clay sampling is quite limited, the textural similarity of the two groups suggests similar transport and depositional regimes. For the channel fill, locally mobilized fine sediment would be transported under low-energy conditions and slowly settle out of suspension in the standing water. The sections of the abandoned Sebes-Körös channel that were sampled were clearly zones of stagnant water with no potential for stream input in the recent past.

Channel bed sediments

Considerably coarser silt and fine sand deposits underlie the fine channel fill sediments. This sediment is texturally indistinguishable from the lateral accretion deposits underlying the *zug* surface and somewhat coarser than the sediments comprising the rest of the landscape (Table 2.2). These sediments could often be distinguished from the channel fill by their more brightly mottled coloring. Local groundwater, enriched in oxygen, could move through these coarser and hence more hydraulically conductive sediments relative to the overlying fine fill. The much lower carbon content in the channel bed sediment would permit the oxidation of iron compounds, producing bright mottling relative to the gleying of the recent channel fill. The transition from channel bed material to underlying, pre-channel sediment was often difficult to discern and in some cases may not have been reached. Some cores, however, extended through the channel bed sediments to underlying more cohesive, calcareous silty clay similar in texture to subsoil material away from the channel meander belt. This sediment appears to be the same infusion loess that dominates much of the eastern Sebes-Körös River basin. The boundary represents the depth of the channel activity during the later phase of river activity at Vésztő-Mágor and roughly corresponds to the base of the lateral accretion deposits underlying the *zug* surface.

Channel dimensions

The two channel cross-sections yielded similar dimensions, with a pre-canalization channel width of about 25 m and bankfull depth of 2.5 to 3 m (Figure 2.7). The channel width estimates are fairly well constrained by the stratigraphy in the cores adjacent to the channel. The channel bed elevation during former bankfull flow conditions cannot be readily estimated, although it was probably close to the upper boundary of channel bed sediments. Therefore, the bankfull cross-sectional area estimate of about 70 m^2, while fairly rough, provides a reasonable estimate of channel size (Table 2.4). Given the uncertainty of the origin of the berm material and other possible disturbances, the actual channel shape at time of abandonment cannot be reconstructed accurately.

Table 2.4. Hydraulic estimates for the Sebes-Körös pre-regulation channel at Vésztő-Mágor

Channel/Basin Parameter	Value
Drainage area (km^2)	4,300
Regional slope	0.0001
Channel sinuosity at Vésztő	2.15
Channel slope at Vésztő	0.000046
Bankfull channel X-section (m^2)	75
Manning's n (grassy channel)	0.35
Bankfull mean velocity ($m\ s^{-1}$)*	0.35
Bankfull discharge ($m^3\ s^{-1}$)	26
24-hour discharge at bankfull ($10^6\ m^3$)	2.2
Equivalent flooded area 1 cm deep (km^2)	220
Thornthwaite PET in May ($cm\ d^{-1}$)	0.3

Note: *Bankfull mean velocity based on Manning equation.
Table by Tod A. Frolking.

The Sebes-Körös channel dimensions at the Vésztő-Mágor tell appear to be quite small for the basin drainage area of about 4,300 km^2. The channel is much smaller than the regulated Sebes-Körös River floodway (between artificial levees), which has a capacity many times greater and is therefore designed to handle much greater quantities of basin runoff than the bankfull flow of the old channel. The estimated pre-regulation channel capacity conforms closely to the predicted bankfull channel cross-section for a basin of similar drainage area in the flat, poorly drained Lake Agassiz ecoregion in northwestern Minnesota and eastern North Dakota in the United States (Simon et al. 2004). It is reasonable to assume that the hydrologies of these two regions were similar, with poorly developed drainage networks and therefore poor hydrological connection of the main channels with much of the flat landscape.

Holocene channel activity

Two cores on the Vésztő-Mágor-zug and one on the Tér András-zug yielded datable carbon material within sandy silt lateral accretion deposits (Table 2.3; Figure 2.6). In addition, a fragment of Árpádian Age pottery (eleventh to thirteenth century AD) was found at 2 m depth about 20 m inward from the present channel location (Figure 2.7). Each of these dates provides a maximum age for channel deposition at that location. While the coring along a single transect generally parallel to the channel meander axis is insufficient to reconstruct changes in meander plan form over time, the fairly linear relationship between age and distance from the channel along the meander axis suggests a mean channel meander southward migration of about 1 m per 30 years through the middle to late Holocene. The presence of artifact-rich colluvium overlying the 8400–8600 BP lateral accretion deposits immediately to the south of the tell suggests that the Sebes-Körös River channel was in this location prior to significant construction and erosion at the Vésztő-Mágor tell site. It appears as though the west limb of the channel meander has undercut the colluvial apron on the west flank of the tell site (Figure 2.6). Coring to the west of this reach of the channel could help better constrain the history of channel activity at this location. Changes in position of the east limb of the meander through time have not been determined.

Clearly, more dates along other reaches of the prehistoric Sebes-Körös channel would help develop a more quantitative assessment of the stream channel's history. Nonetheless, the dates we currently have suggest that the Sebes-Körös channel, particularly in the section from Okány west to the confluence with the Kettős-Körös River below Körösladány, has not changed position much over the past 8,000 years, with only a modest amount of meander migration. Given that there is no environmental information to support a significant change in fluvial conditions during the Holocene, the Sebes-Körös channel probably has been stable, with no avulsion activity, since the early Holocene.

Channel Dimensions, Hydraulic Estimates, and Implications for Basin Hydrology

Some basic hydrological calculations (Table 2.4) suggest that the Sebes-Körös channel would have played a minimal role in both delivering floodwater to the poorly defined floodplain and draining water from flooded areas. The high channel sinuosity coupled with the extremely low floodplain gradient results in sluggish flow velocity estimates and hence low bankfull discharge. For example, at the estimated bankfull flow (Table 2.4), the Sebes-Körös River at Vésztő could drain only 0.53 mm per day of equivalent water depth from the drainage basin. This water flux rate compares with potential evapotranspiration rates of approximately 2 mm per day in April, 3 mm per day in May, and 4 mm per day in July based on 1981 to 2001 climate data for Békéscsaba (capital of Békés County) and on the Thornthwaite evapotranspiration

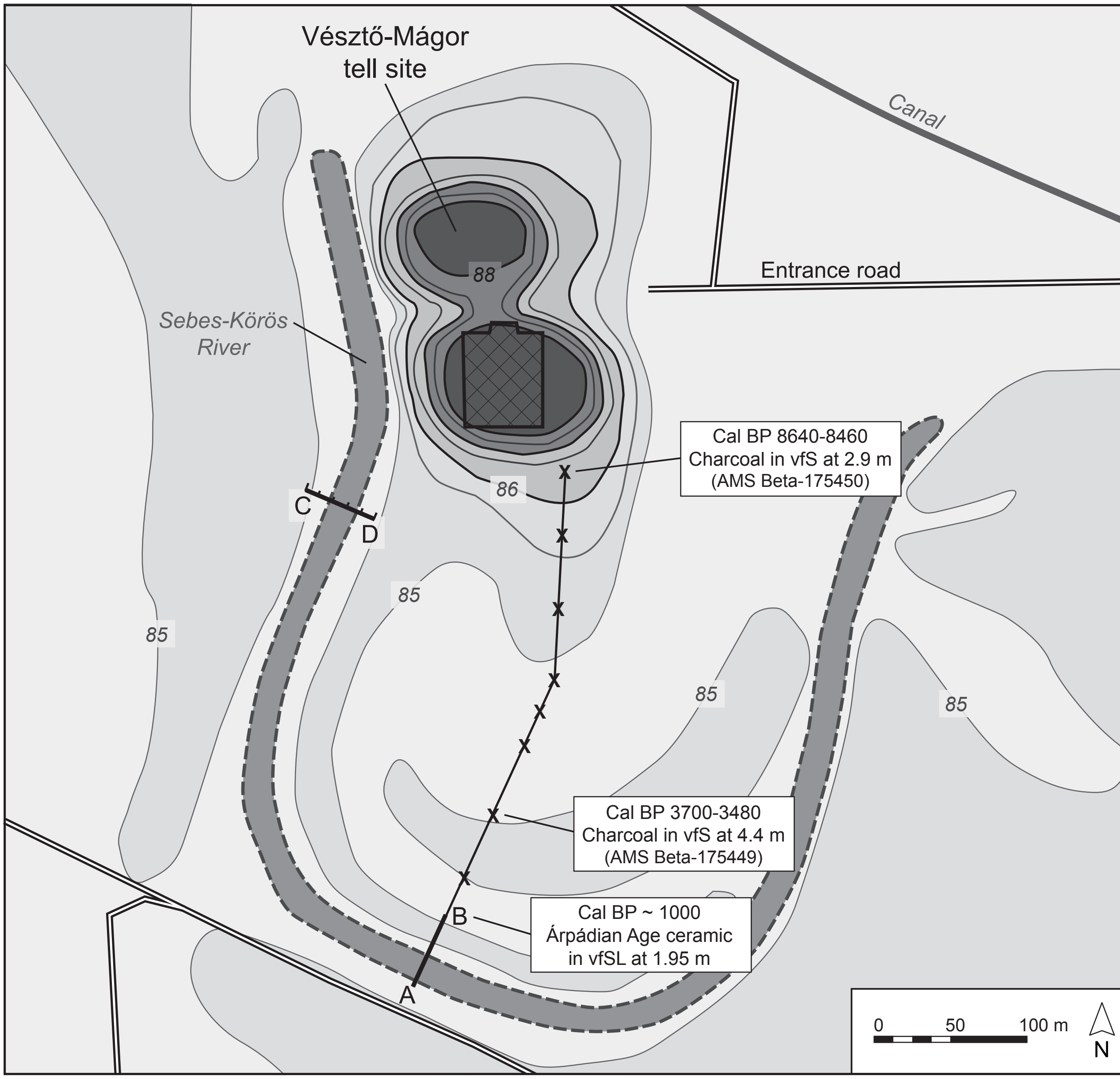


Figure 2.6. Map of Vésztő-Mágor meander loop (*zug*) of the pre-regulation Sebes-Körös River channel with the Vésztő-Mágor tell site. Xs indicate locations of cores. Text boxes indicate approximate ages of sediments at dated locations. Channel cross-sections cored along line A–B (see Figure 2.7) and line C–D were selected because of minimal artificial channel modifications. *Figure by Tod A. Frolking and Jill Seagard.*

method from Dingman (2002). Thus, under virtually all conditions, evaporation would have been much more significant than channel drainage for water removal from much of the basin.

Similarly, the channel within the Hungarian portion of the Körös Basin would not have been capable of delivering significant floodwater to the extensive, poorly drained flats away from the channel. This brings into question the widely reported annual flood regime that was thought to have had a late spring flood peak driven by snowmelt in the Apuseni Mountains and a summer peak from summer rainstorms (Kosse 1979; Parkinson 2002; Pécsi 1970; Sherratt 1983a). With the given channel characteristics, for example, very little of the water that resided seasonally on the Nagy-Sárrét and Kis-Sárrét east of Vésztő could have been delivered from the upper portion of the catchment in Romania via channel flow. Based on hydrological modeling work of Gillings (1995) in the middle Tisza

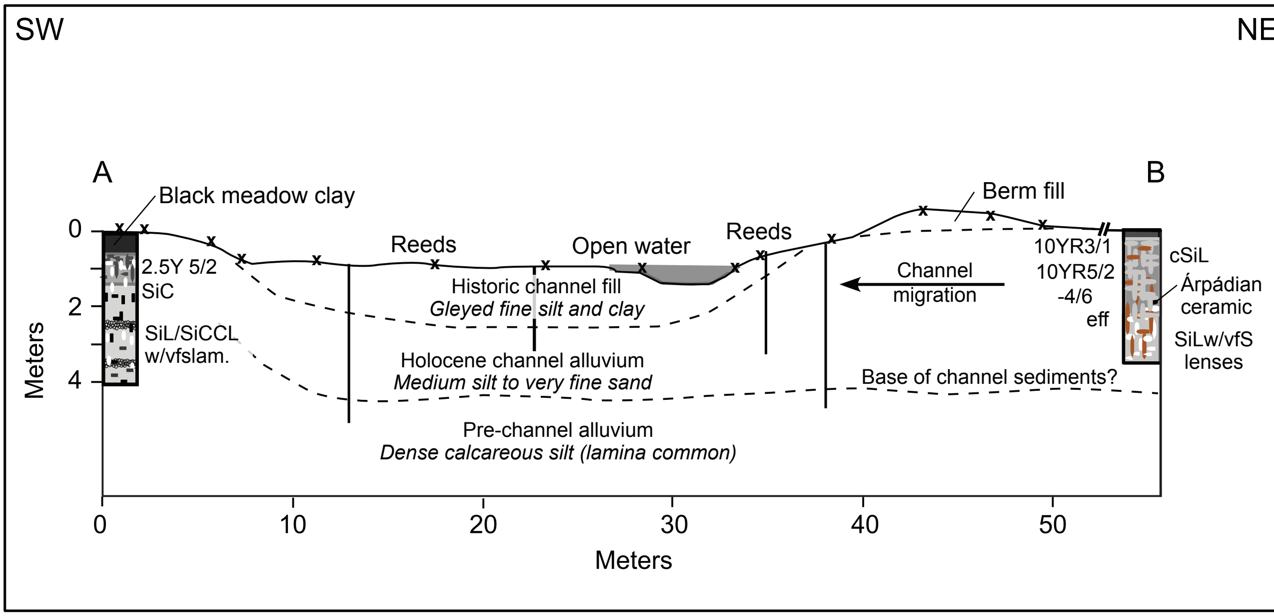


Figure 2.7. Sebes-Körös River channel cross-section A–B (see Figure 2.6) south of the Vésztő-Mágor tell showing soil/sediment profiles typical of the meander loop, overbank deposits, channel bed material, and overlying post-regulation channel fill. *Figure by Tod A. Frolking and Jill Seagard.*

region, as well as general terrain reconnaissance and topographic map study of the lower Körös Basin, it also seems unlikely, given the very low topographic gradients and the poor hydrological connectivity of different fields at shallow flood levels, that much water could move westward down basin as overbank flow or floodplain sheet flow. Therefore, for much of the lower Körös River basin, seasonal floods were the result of local precipitation events. Most standing water fell as local precipitation and, with very slow infiltration and percolation through the tight meadow clay soils, would have seeped slowly overland to landscape depressions and then evaporated. Shallow groundwater fluxes would have been exceedingly slow in this flat terrain and could not have played much of a role in either the flooding or drainage of the extensive flat terrain. The somewhat coarser lateral accretion deposits underlying the *zug* surfaces (Table 2.2) would allow for somewhat faster percolation and lateral subsurface flow to stream channels on the active meander plain. Thus, these surfaces may have been more suitable for cultivation and grazing than the more poorly drained, distant flats following wet periods.

Clearly, reliable cross-section measurements of pre-modification channels in the middle to upper basin as well as careful topographic modeling of the land surface in the lower basin are needed to better resolve the region's hydrology. Hydrological modeling, for example, might indicate that the eastern margin of the Nagy-Sárrét and Kis-Sárrét in the vicinity of the modern Hungarian–Romanian border received some allogenic floodwater because of the greater regional slope and channel gradients along the eastern margin of the Great Hungarian Plain in western Romania. Thus, the eastern margins of the Nagy-Sárrét and Kis-Sárrét may have tended to be wetter for longer periods than the western margins of the Kis-Sárrét near Vésztő.

To the west, the middle and lower reaches of the Tisza River were subject to widespread flooding prior to river regulation in the mid-1800s. Some records indicate that as much as 33 to 50 percent of the floodplain was often inundated during spring floods (Lóczy 1988), although work by Gillings (1995) suggests that perhaps 15 percent of the modeled Tisza plain near Polgár (about 150 km north of the Körös confluence) would have been frequently inundated during spring floods. Given the very low regional channel and land surface slopes, it is likely that flooding of the middle Tisza River basin would have backed up into the lower Körös Basin as well.

Swells, Swales, and Paleochannels

The Vésztő-Bikeri and Körösladány-Bikeri sites occupy a local topographic high at 86 masl that lies about 1–1.5 m above the surrounding flat plain (Figure 2.4). Topographic maps (1:10,000 and 1:25,000) reveal many such sublinear to arcuate topographic highs in the area, often in close proximity to arcuate depressions that have the appearance of discontinuous meandering channel segments. For example, the short paleochannel remnants or depressions illustrated in Figure 2.3 were identified by having at least 1 m of local relief (two successive contour lines on 1:25,000 topographic maps). Given the patterns of these features, one is drawn to the conclusion that these swells and swales have a fluvial origin, most likely abandoned channels and adjacent natural levee deposits. The lack of linear continuity of these terrain features, as well as the general similarity of subsurface sediments along crests and adjacent flats for the few sites that have been cored, does not support this interpretation. Perhaps the landscape has been modified to some degree following the formation of what originally were more continuous linear features. Given the very slight slopes, it is difficult to hypothesize just how the terrain would be modified in any significant way unless by human activity (such as using spoil from the surrounding ditches to build up the center of the villages). For example, at the Bikeri locality, the surface extending south from the Vésztő-Bikeri site to the 85 m swale has a maximum slope gradient of about 3 percent—too slight to promote significant sediment transfer. In some locales, however, these sinuous depressions are continuous for many kilometers and clearly appear to be paleochannels (Gyucha et al. 2011; see also Chapter 3, this volume).

The timing of the formation of these rises and swales and their subsequent evolution are important for the archaeological interpretation of the area. The geographic distributions of both Neolithic and later sites show strong correlations with topographic highs close to stream channels (Gyucha and Duffy 2008; Gyucha et al. 2011; Kosse 1979; Parkinson 2002). Given the preponderance of flat, poorly drained terrain in the lower Körös Basin, the slight topographic highs would provide the most suitable habitation sites. Their proximity to surface water channels would provide the greatest range of environmental niches over short distances, and they would have accessible water during dry periods. It is important to understand the region's landscape history and the evolution of these features to assess whether suitable habitation sites have changed over time. An early question about the settings of the Vésztő-Bikeri and Körösladány-Bikeri sites was whether those locations had been chosen because of their proximity to a body of water, perhaps an active channel, in the Bikeri depression during the Early Copper Age. The dating of channel activity at the Vésztő-Mágor tell indicates that the Bikeri terrain features are significantly older than the Copper Age (see also Chapter 3, this volume).

Looking at the lower Körös River basin more broadly, the apparent channel remnants on topographic maps and aerial photos may have several different origins. Many of the smaller channels with short meander wavelengths may have been locally sourced drainage ways that naturally followed preexisting landscape depressions. The first and second Habsburg military survey maps reveal a number of small, generally sinuous channels or streams flowing into or out of nondescript broad flats mapped with marsh/wetland symbols (Gyucha et al. 2011; see also Chapter 3, this volume). These low-energy, shallow streams would have had very low sediment yields and may have developed fairly stable meandering paths. These likely would have been vernal channels, active only under saturated soil conditions or following heavy rains. These channels may have had contributing areas of several tens of square kilometers. It is unlikely that overbank deposition from these small channels could have formed any natural levees or levee-like features in the landscape.

The channels of the larger through-flowing streams (the paleochannels of the main Körös River branches) appear to have somewhat different histories and dynamics. In some reaches, they may have had multiple contemporaneous channels and thus formed broadly dispersed anastamosing systems. The very low regional gradients, the cohesive bank sediments, the low flow energy conditions, and the probable presence of trees and hence large woody debris within channels would all favor the development of anastamosing channel patterns (Makaske 2001). This certainly appears to be the case for the Fehér-Körös River and especially the Fekete-Körös channels in the vicinity of Sarkad, Doboz, and Békés. The first Habsburg survey maps reveal an anastamosing system for the Fekete-Körös River below Doboz with what appear to be two active channels separated by as much as 2 km in places; see, for example, the main channel of the Kettős-Körös River and multiple subsidiary channels near and south of Bélmegyer (Figure 2.3). In some cases, following an avulsion event, the old channel would eventually be abandoned, yielding long, partially filled paleochannel remnants. In low-energy environments, such as the lower Körös River system, the abandonment of a channel can be a very slow process requiring many hundreds of years. On the very flat, unconfined Körös River plain, an avulsion event could easily lead to a dramatic shift in channel location. The lack of any significant lateral changes in basin elevation on topographic maps (with a 1 m contour interval) suggests that active channel aggradation was not a primary cause of channel avulsion in recent times. That is, the pre-canal channel margins do not appear to have higher elevations than the more distant flats.

The short, discontinuous meandering to curvilinear swell and swale features that, for example, are apparent to the north and northeast of Vésztő (Figure 2.3) may reflect a fluvial regime different from the dominant hydrological system during the middle to late Holocene. It seems likely that these features were created by relatively short-lived channels active during a time of higher sediment loading that would cause more rapid channel aggradation and subsequent abandonment through avulsion events. As the basin aggraded during the late Weichselian, both fluvial and remobilized aeolian sediments could partially fill former channel depressions. The disconnected pattern apparent today could reflect the final stage of this process as the landscape stabilized during the late Weichselian–Holocene transition. For examples of similar fluvial shifts in other European drainage systems during climate transitions, see Vandenberghe (1995).

Large meander wavelength channels, such as that near the Bikeri locality (Figure 2.4), likely were created during a period of relatively high effective runoff that would have led to the development of larger stream channels (Dury 1964). A channel's meander wavelength correlates strongly with mean channel width, which in turn can be linked to bankfull discharge (Leopold et al. 1964). There are numerous European examples of stream systems whose late Pleistocene meander wavelengths were several times greater than at present (Kasse et al. 1995; Szumański 1983; Vandenberghe 2001; see also Chapter 3, this volume). Even with a similar low channel gradient, the much larger Tisza River has been a more dynamic fluvial system during the Holocene than the lower Körös River system. Above the Körös confluence, the Tisza River shows clear evidence of active meandering, with common point bar scrolls and meander cutoffs. Many of the higher surfaces in the Tisza Valley are loess-mantled, Late Pleistocene channel bar deposits (Gillings 1995; Sümegi 2004). Unlike the Körös River tributaries but like most streams of central Europe, the Tisza underwent a modest period of incision during the late Weichselian–Holocene transition, leaving relatively well-drained, stable terrace surfaces that would be well suited to habitation (Sümegi 2004).

Conclusions

While this geomorphological study was not able to resolve all the details of landscape development and hydrology in the study area during the Late Neolithic and Early Copper Age periods, numerous conclusions that have important implications for the archaeological study of the lower Körös River region can be drawn from longer-term evidence of Holocene geomorphological activity.

To understand the landscape's form and composition, the analysis must be extended back into the late Pleistocene. At this time, the lower Körös River basin was situated in a structural trough, so an alluvial depocenter developed, resulting in a terrain comprised of fine-grained sediment with exceptionally low relief. The deep core at Vésztő indicates a mean sedimentation rate of 20 cm/ky through the middle to late Pleistocene, with the bulk of sedimentation likely occurring during glacial periods. Shallow cores across much of the landscape revealed thin silty sand lenses within silt to silty clay deposits that likely reflect some degree of water transport and sorting associated with the late Weichselian loess fall. This study has not determined the overall importance of larger-scale channelized flow and associated sediment mobilization and redistribution during this period. The Holocene channels of the Körös tributaries have not incised into the late Pleistocene deposits of the lower basin. Hence there are no terrace surfaces or even significant stream bank relief in the region.

With a vegetated landscape, minimal aeolian input, and very flat stream gradients during the Holocene, there does not appear to have been much sediment transport and alluvial deposition within the basin. The most notable landscape transformation has been the development of relatively shallow, 0.3–1 m thick, fine-textured, black meadow clay profiles on flats and in gentle depressions. Some of the meadow clay appears to reflect local transfer of very fine sediment from higher to lower topographic positions and hence would indicate a slight overall flattening of the terrain during the Holocene. Based on cores near the Sebes-Körös River, some of this dark, fine-textured material also has an alluvial overbank origin. The hydraulic conductivity of meadow clay profiles may have degraded over time; the accumulating smectitic clay would inhibit vertical drainage when wet. The poor drainage would in turn reduce mineralization of organic material and thus would enhance the melanization of these thick cumulic A horizons.

Several radiocarbon dates and diagnostic ceramics associated with lateral accretion deposits of the Sebes-Körös channel near the Vésztő-Mágor tell suggest a mean middle to late Holocene channel migration rate of about 3 m per 100 years for this highly sinuous channel, and the river's local pattern indicates no meander cutoffs or channel avulsion events in the last 8,000 years. The fluvial deposits within this meander belt are modestly coarser than the widespread infusion loess but still have mean particle sizes well within the silt range, indicating both very low stream energy and a lack of sediment coarser than fine sand within the lower basin.

With the general stability of this landscape during the Holocene, suitable sites for human occupation would not have changed significantly over time. Modest rises near perennial stream channels would have been the most desirable sites throughout the Holocene (Gyucha et al. 2011; see also Chapter 3, this volume). Given slow rates of channel migration, flowing streams would have remained near these sites. Site desirability would have been enhanced by the accumulation of cultural material in tell layers at some locations. This would improve drainage and provide better views of the surroundings.

The sediment below the plowzone that forms the slight topographic rise at the Vésztő-Bikeri and Körösladány-Bikeri sites is similar in texture to other subsurface cores. The bulk of the sediment is silt and clay. Slight variations in texture down through several cores suggest an infusion loess mode of deposition. Based on the limited number of cores, there is at best a weak sense of a fining-upward trend within the stratigraphy at and below the Early Copper Age settlements. Nearby cores have not revealed any obvious coarser channel deposits at depth. Therefore, the gentle swells where the two villages were located remain enigmatic and would require a denser coring, sampling, and particle-size analysis strategy to tease out stratigraphic patterns that might explain their origin. Perhaps the topographic highs represent some type of fluvial levee deposition associated with an adjacent aggrading channel. Given the large amplitude of the apparent meanders and the relatively large local relief, these features likely date to the late glacial, when the depositional environment was clearly more dynamic than during the Holocene. Whatever their origin, these slight rises, with their relatively good drainage, represent suitable habitation sites, although they lack the perennial surface water supply present near active Holocene river channels.

Chapter 3

Paleohydrological Reconstruction of the Körös Region

Attila Gyucha and Paul R. Duffy

Studies of the context of human settlements on the landscape of the Great Hungarian Plain indicate that most sites were located near rivers, streams, or lakes (Gyucha et al. 2011; Kosse 1979; Sümegi 2004; Sümegi et al. 2003, 2005; Szathmáry 1982). This seems to have been the case in the lower Körös River study area as well (Figure 3.1). The network of modern rivers and drainage canals in this area was created over the last 200 years. Thus it provides only limited information about the "natural," pre-regulation water system before river channels were straightened, artificial levees were built, and marshes were drained. This modern hydrology does not reflect the land-use practices of the ancient inhabitants. A reconstruction of the Holocene paleohydrology of the region was required to provide a baseline for the paleoenvironmental investigations conducted by the Körös Regional Archaeological Project. These multidisciplinary studies were undertaken to gain a better understanding of settlement systems and land-use practices during the Early Copper Age.

The network of paleochannels in the study area was reconstructed and examined at regional, subregional, and micro-regional scales. Historical charts, topographic maps, aerial photos, and landscape descriptions were consulted, and archaeological data collected during systematic surveys in the Körös region also were examined to reconstruct the Holocene paleohydrology. We began with data that had been collected during the Archaeological Topography of Hungary (Magyarország Régészeti Topográfiája; henceforth MRT) survey project in the northern part of Békés County. More than 75 percent of the 3,798 km^2 MRT survey area (2,857 km^2) is located in the Körös River drainage. This includes the catchments of the Sebes (Rapid)-Körös, Fekete (Black)-Körös, and Fehér (White)-Körös River branches and the Körös–Berettyó Interfluve. The southernmost portion of the survey area includes 941 km^2 of the Pleistocene alluvial fan of the Maros River (Figures 3.1 and 3.2). The geomorphology and environmental history of the Maros Fan are substantially different from the Körös region (Gyucha et al. 2011). The vast majority of paleochannels crossing the fan are of Pleistocene age. Since aeolian processes also have shaped this landscape, only the most important hydrological features were reconstructed in this area.

Previous geomorphological investigations provided useful information that was used to create and evaluate the paleohydrological reconstruction. The first model of the ancient hydrology of the Sárréts (Mud Meadows) along the northern edge of the study area (Figure 3.1) was proposed in the 1950s (Papp 1956). Later, Nandris (1970) discussed how changes in groundwater levels affected prehistoric communities in the Körös region. Subsequent to Nandris's work, several long-term archaeological research programs were conducted at local or micro-regional scales on the Great Hungarian Plain, and

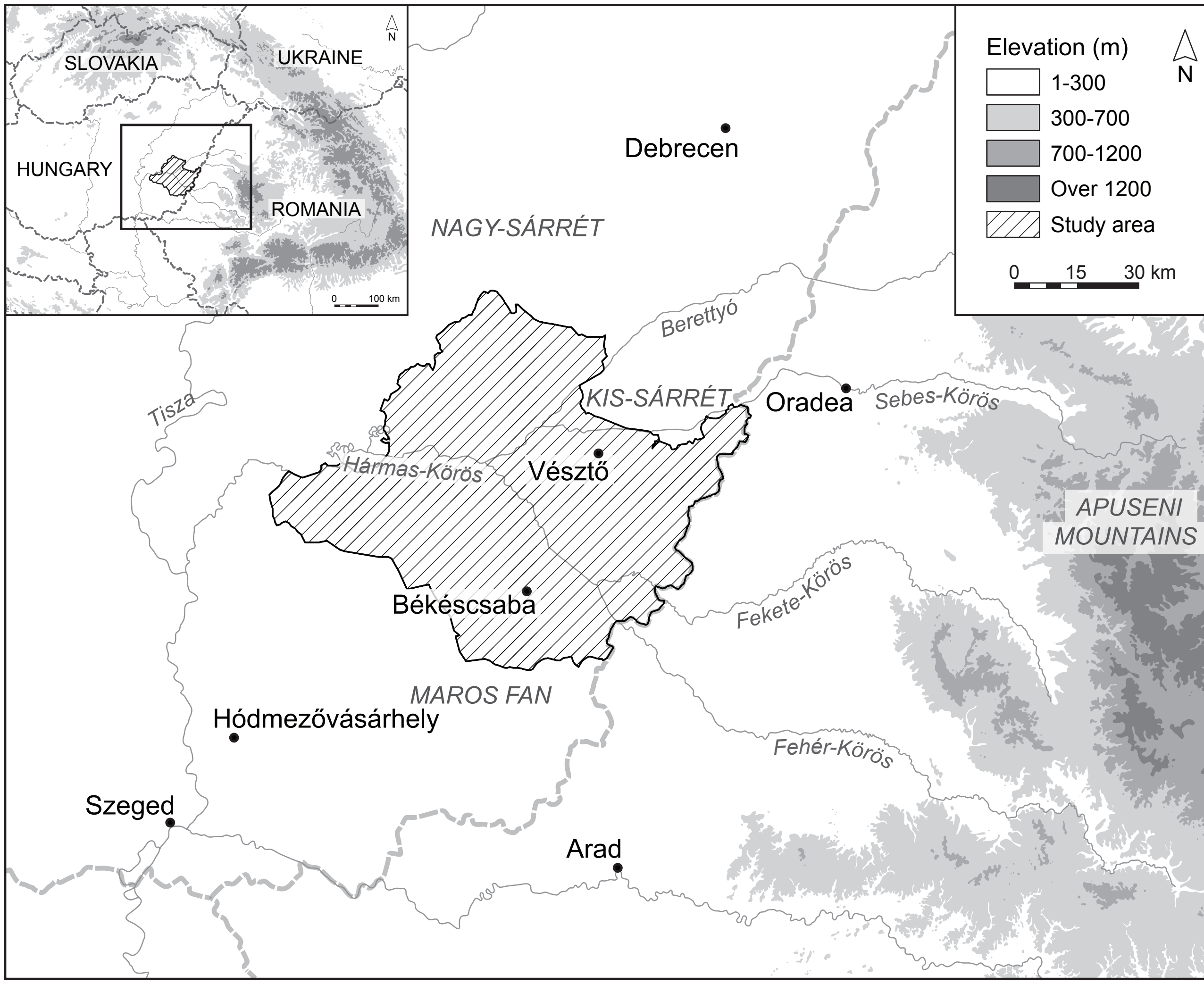


Figure 3.1. Location of the study area (hatched) within the modern Körös River system. Inset shows the location in the Carpathian Basin. *Figure by Jill Seagard and Paul R. Duffy.*

geoarchaeological investigations often were included in these projects (Gillings 1995, 1996, 1997, 1998, 2007; Jerem et al. 1992; Molnár and Sümegi 2007; Sauer 2007; Sümegi and Molnár 2007; Sümegi et al. 2002; see also Chapter 2, this volume). In addition, significant paleohydrological and sedimentological studies focused on the development of the Quaternary (mostly Pleistocene) paleohydrology of the Körös region (Gábris and Nádor 2007; Nádor et al. 2007, 2011; Thamó-Bozsó et al. 2002).

The Quaternary Hydrology of the Körös Region

The Körös region is a shallow basin several meters lower and deeper than the surrounding physiographic regions, where alluviation, erosion, and tectonic activities shaped the landscape (Mike 1991:647; Sümeghy 1944; see also Chapter 2, this volume). The differences in surface elevations in the study area range between 83 and 102 masl. A Miocene Pannonian lake in this region had been connected to the sea, but it was isolated by the late Pliocene. The lake basin was filled gradually by alluvium deposited by streams flowing from the northeast and northwest (Bérczi and Phillips 1985; Magyar et al. 1999; Mike 1991). Most of the flat features in the landscape were established at this time. However, complex tectonic activities resulted in a gradual depression of the alluvial basin, while peripheral areas were elevated. Different branches of the ancient Tisza and Danube Rivers deposited additional alluvium in the basin. At some locations, the depth of Pleistocene

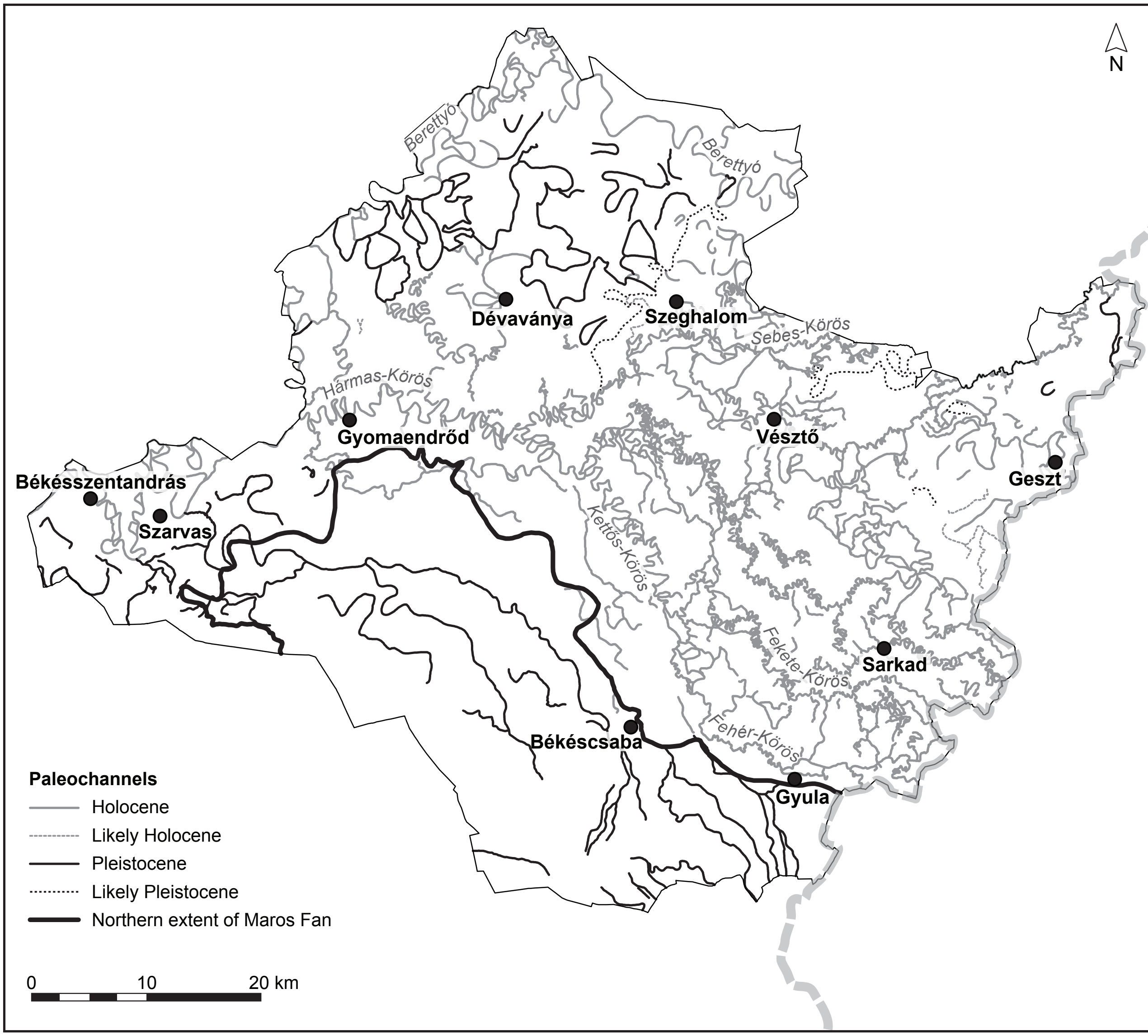


Figure 3.2. Distribution of Pleistocene and Holocene paleochannels in the study area. Only the major Pleistocene channels within the Maros Fan are shown. *Figure by Jill Seagard and Paul R. Duffy.*

deposits exceeds 500 m. The subsiding Körös region was the main basin for collecting alluvial deposits in the eastern part of the Great Hungarian Plain. Core records show that during the second half of the Pleistocene, tectonic activity induced the Tisza River to migrate back and forth across the region (Borsy 1990; Gábris and Nádor 2007; Mike 1991; Schumm et al. 2000).

Alluviation and erosion by the Sebes-Körös and Berettyó Rivers also contributed to the creation of the alluvial plain. In the same period, the course of the ancient Maros River was shifting southward and created the large fan in the southern edge of the study area (Mike 1991:660; Somogyi 1969a:309). By the end of the Pleistocene, smaller basins along the margin of the Great Hungarian Plain also had subsided and influenced the hydrology of the Holocene Körös River network (Gábris and Nádor 2007). The ancient Tisza abandoned the Körös Basin toward the end of the Pleistocene and occupied its pre-regulation riverbed, which was formed by the ancient Bodrog River (Gábris 1998). At roughly the same time, the ancient Fekete-Körös and Fehér-Körös Rivers flowed at the margin of the study area, southeast of the current Kettős (Double)-Körös and Hármas (Triple)-Körös Rivers. By the beginning of the Holocene, the Körös River branches were flowing along their pre-regulation courses (Mike 1991:662; Nádor et al. 2007, 2011).

The maps and written descriptions of these rivers before regulation reveal a remarkably complex hydrology in the Körös region. Along with the major Körös River branches and the Berettyó River, a sinuous network of permanent and seasonal rivers and streams flowed across the flat landscape. More subtle flow regimes also crossed the small and extended marshlands. Prior to river regulation, an area larger than 140,000 ha was inundated by seasonal or perennial flooding. The hydrological cycles influenced, and were influenced by, the residents of the region through their fishing practices, their creation of shipping routes and defensive works, and their construction of water mills (Dóka 1997:26; Huszár 1985 [1823]).

While local-scale hydrological modifications to increase agricultural productivity were made as early as the eighteenth century, systematic water regulation was conducted under the direction of chief engineer Mátyás Huszár in the nineteenth century. From 1829 to 1895, the total length of the Körös River was reduced from 1,041 km to 462 km (Dóka 1997; Huszár 1985 [1823]; Vázsonyi 1973). Construction continued, resulting in a network of several thousand kilometers of canals.

Major Rivers in the Körös–Berettyó Fluvial System

The watershed of the Körös and Berettyó Rivers covers 27,537 km^2. Nearly half of this catchment (12,931 km^2) is located on the Great Hungarian Plain. The major rivers in the system are the Fehér-Körös, Fekete-Körös, Sebes-Körös, Kettős-Körös, and Hármas-Körös, as well as the Berettyó (Figure 3.1). The headwaters of the Fehér-Körös (the southernmost Körös River branch) are in the Apuseni Mountains at an elevation of 980 masl. The river's total length is 235 km, but only 9.3 km are in the Körös Regional Archaeological Project study area. During regulation, a new riverbed was dug from Gyulavári to where it now joins the Fekete-Körös River at Doboz-Szanazug. The 168 km-long Fekete-Körös River originates on the northern slope of the Bihar Mountains at an elevation of 1,460 masl. It now enters the study area southeast of Sarkad. Before regulation, it joined the Fehér-Körös River at Békés.

The post-regulation Kettős-Körös River starts at Doboz-Szanazug, where the modern Fehér-Körös and Fekete-Körös merge, and flows northwest for 37.3 km until it joins the Hármas-Körös River. The Sebes-Körös River headwaters are at an elevation of 710 masl in the northern part of the Bihar Mountains. The total length of this northern Körös River branch is 209 km. The modern Sebes-Körös River enters into the study area at Körösnagyharsány. The length of its modern course within artificial levees is 58.6 km. Flowing westward, the Sebes-Körös River receives the waters of the modern Berettyó River south of Szeghalom. After turning southwest, it joins the Kettős-Körös River between Köröstarcsa and Gyomaendrőd to form the Hármas-Körös River. This final river branch flows westward north of Szarvas until it merges with the modern Hortobágy-Berettyó River at Mezőtúr. This final stretch of the Körös River system flows for 90.7 km before it joins the Tisza River at Csongrád.

The headwaters of the modern Berettyó River are on the border of the Meszes and Réz Mountains, at an elevation of 582 masl. The total length of the river is 205 km, but only 12 km of its course are in the study area. Before regulation, the Berettyó River flowed through the Nagy-Sárrét marshland west of Bakonszeg (Figure 3.2). After leaving the marshland, the river turned south at Bucsa and eventually joined the Hármas-Körös River at Mezőtúr. The modern course of the Berettyó River flows south from Bakonszeg to the confluence with the Sebes-Körös River south of Szeghalom. The modern Hortobágy-Berettyó River occupies the bed of the pre-regulation Berettyó River south of Bucsa. There are only a few natural lakes in small depressions in the study area. Most of the cutoff meanders that still hold water are along the course of the Hármas-Körös River. These were created when the main river branches were realigned during regulation.

The Pre-Regulation Holocene Hydrology of the Körös River System

Recent topographic maps and historic charts frequently are used to document changes in the hydrology of European river systems (Gyucha et al. 2011; Hooke and Redmond 1989; Lajzcak 1995; Uribelarrea et al. 2003). The most important maps for the Körös River hydrological reconstruction were modern topographic maps and sets of eighteenth- and nineteenth-century maps and charts.

For the reconstruction, we used 1:10,000-scale topographic maps with a contour interval of 50 cm, created between 1976 and 1984 based on the Hungarian national datum and projection. We also used two sets of maps produced by the Habsburg Office of Military Geography in Vienna between 1764 and 1915 (Borbély and Nagy 1932; Jankó 2001). The historic maps were georeferenced so they could be overlaid using GIS (Arcanum 2006a, 2006b).

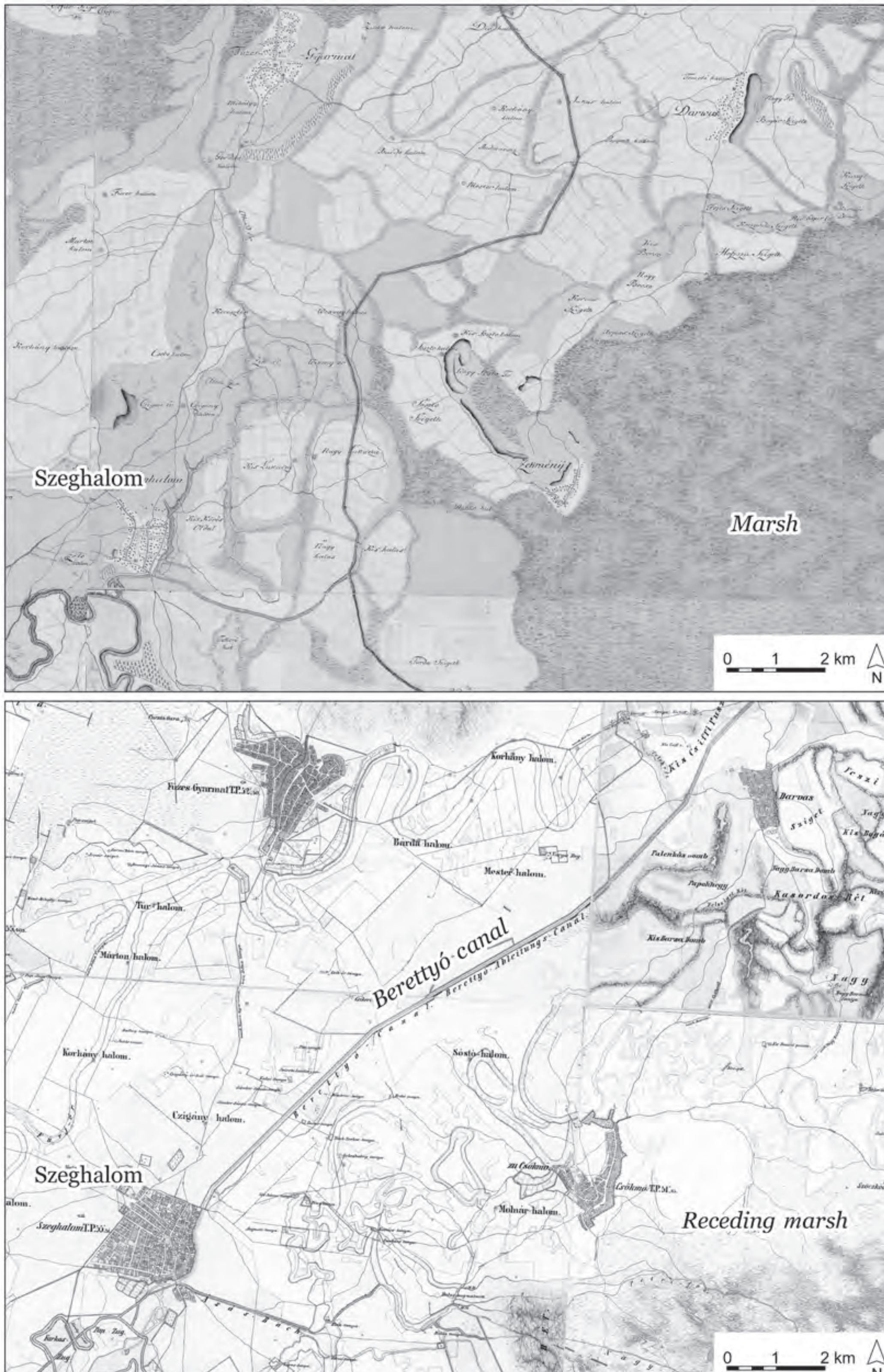


Figure 3.3. Maps of Szeghalom and the surrounding area completed during the first (top) and second (bottom) military surveys. On the top map, the oxbow lakes west of the marsh occupy the bed of Csecseri Creek. On the bottom map, the Berettyó Canal has been built to straighten the river channel, the Kis-Sárrét marshland, in the bottom right, has been drained, and the Csecseri Creek has silted in. *Figure by Jill Seagard and Attila Gyucha.*

The 1:28,800-scale Habsburg maps provide detailed topographic data and show river features. The maps of the first military survey of the Habsburg Empire were made between 1782 and 1785 for Hungary, before major water regulation campaigns had begun (Borbély and Nagy 1932). Thus they exhibit the pre-regulation hydrology. However, the second Habsburg series is more accurate. It used a steady geodetic base and standard projection (Gyucha et al. 2011; Jankó 2001; Timár 2004). When the two series of maps are compared, changes in the landscape after regulation are clear (Figure 3.3).

In addition to these maps, we consulted several other old maps, such as Hevenesi's (1689) map and the series of maps made by Huszár between 1818 and 1823, at the beginning of the systematic water regulation projects. Huszár's 1:36,600-scale maps show the rivers and marshlands that were to be regulated, and the engineer also published detailed descriptions of hydrological features of the Körös region as a supplement to his maps (Huszár 1985 [1823]). A georeferenced series of 1:100,000-scale agro-topographic maps published in 1983 contain topographic information and characteristics of different soil types, including their water retention and natural fertility. When these data were compared with Huszár's maps, considerable continuity in soil conditions before and after regulation was evident (Gyucha et al. 2011).

Aerial Photographs and Archaeological Survey Results

High-resolution aerial photographs taken in 2000 were used to complement data from the topographic maps. By comparing active meanders and cutoff pre-regulation river channels shown on topographic maps and aerial photos, the configuration of the old watercourses could be reconstructed. On the aerial photos, paleochannels are represented by continuous lines that are darker, or more rarely lighter, than their surroundings (Figure 3.4).

The aforementioned MRT archaeological surveys started in the 1960s in the Körös region and focused on locating archaeological sites and determining their extent and periods of occupation. These surveys covered an area of 3,798 km^2 in the study area, and the results from the Szeghalom, Szarvas, Békés, and Békéscsaba parishes were published in three volumes (Ecsedy et al. 1982; Jankovich et al. 1989, 1998; see also Chapter 1, this volume). By permission of the authors, we also were able to use currently unpublished data from surveys of the Sarkad and Gyula parishes as well (Szatmári in prep.). Site locations recorded during the MRT surveys were compared with the courses of ancient rivers and streambeds, and the locations of ancient marshes and wetlands (Gyucha et al. 2011).

Methods Employed in the Hydrological Reconstruction

After they were digitized, the topographic maps, the first and second series of Habsburg military survey maps, and the aerial photographs were converted into a common projection and overlaid in ESRI's ArcGIS 9.0. These data were used to trace the paleochannels in the study area. The Huszár and Habsburg maps were compared with modern topographic maps to separate patterns in the landscape that resulted from natural hydrological development from ones that can be attributed to regulation and artificial constructions (Gyucha et al. 2011).

Paleohydrological features were created as vector polylines, starting with the least ambiguous and spatially most accurate topographic maps. First, the largest and most obvious features of the landscape were digitized, following the ancient channels, until we were unable to recognize them in any of our sources. Each separate channel received an ID number and a name (if one appeared on the topographic or Habsburg maps) and a description of its geographic position and attributes such as width, depth, meander loop curvature, and observed relations to other hydrological features. As noted above, due to major differences in landscape evolution, the paleohydrology of the Maros Fan was not reconstructed as systematically. Only its most obvious hydrological features were digitized.

To gain a better understanding of the development of the Holocene hydrology in the Körös region, it was necessary to keep track of the settlement history along each documented watercourse. Using the original maps and site descriptions of the MRT surveys, we plotted site locations from the Early Neolithic period to the end of the Middle Ages along each identified paleochannel and added these to the GIS database for further analyses (Gyucha et al. 2011). From these distributions, the ante quem dates of the paleochannels could be estimated. We assumed that sites located within 100 m of the edge of a paleomeander were situated so that the river and its immediate surroundings would provide resources and facilitate travel for the inhabitants. In other words, we assumed that sites were located there so they would be near a river channel.

The Reconstruction of Early Copper Age Hydrology in the Study Area

Previous investigations of the pre-regulation hydrology of the Körös region assumed that the landscape was unstable, with meandering rivers that frequently shifted their channels throughout the Holocene (Dóka 1997; Gábris

Figure 3.4. The Korhány Creek channel, a typical Holocene-age meander near Geszt. The 1:10,000 topographic map (top) and the aerial photo (bottom) show the same paleochannel of this abandoned stream. *Figure by Attila Gyucha.*

and Nádor 2007; Papp 1956; Pécsi and Sárfalvi 1960; Somogyi 1969b). Archaeologists have used this model to explain environmentally driven changes in settlement patterns in the region (Kosse 1979:70; Sherratt 1983a).

The results of our analysis using the combination of paleohydrological and archaeological data do not support this assumption for the Körös region. When settlement data are compared to the reconstructed hydrology, the courses

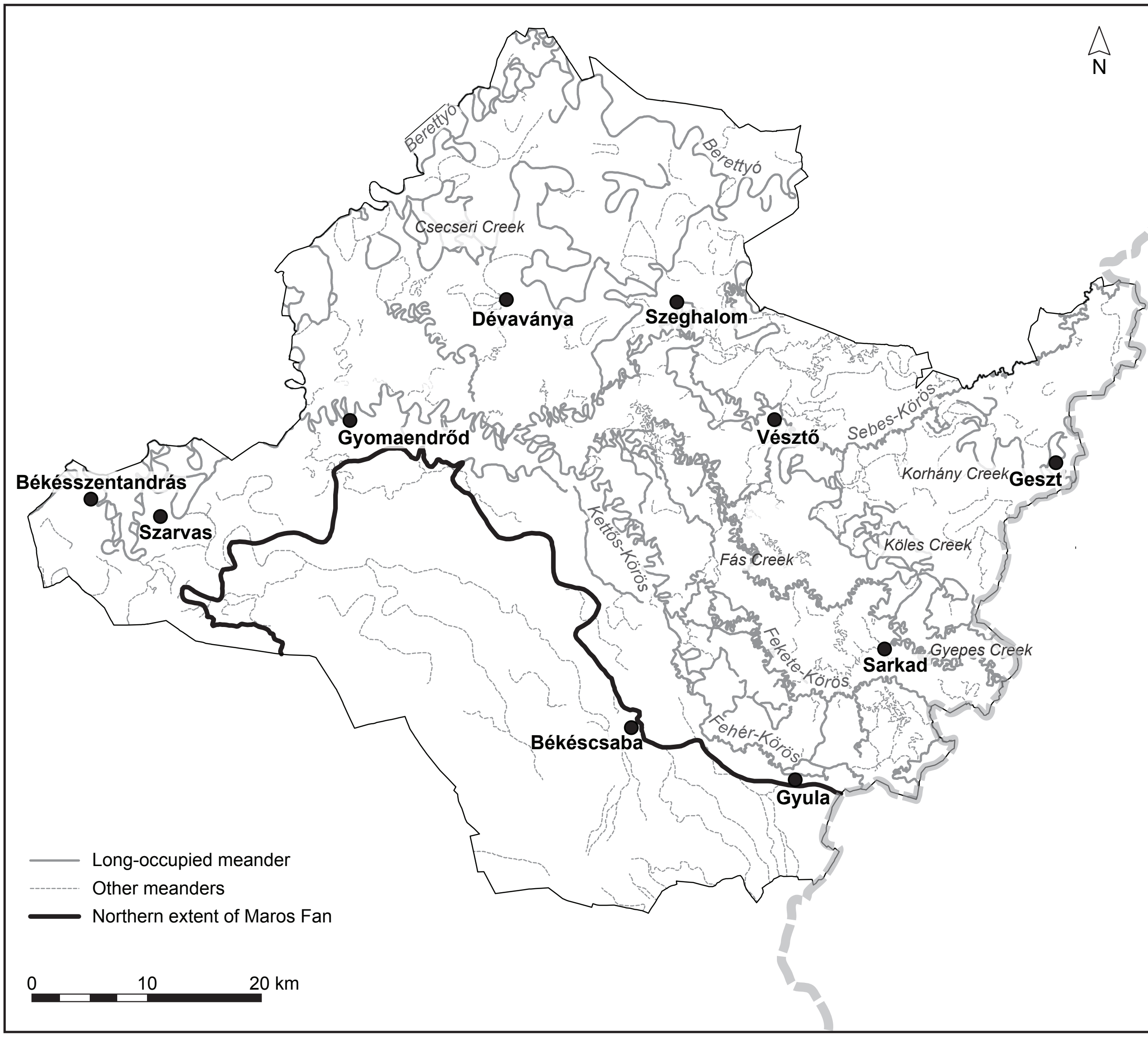


Figure 3.5. Paleochannels in the study area with sites dating from the Neolithic period to the Middle Ages located on their banks. *Figure by Jill Seagard and Paul R. Duffy.*

of the Körös River branches, the Berettyó River, and the smaller tributaries and streams all seem to have been stable for at least the last 8,000 years, since the first sedentary agricultural groups occurred in the region (Figure 3.5). Most of the channel segments we identified were occupied from the earliest phase of prehistory until the end of the Middle Ages. In addition, when the hydrology reconstructed from topographic maps and aerial photos is overlaid with the Habsburg military surveys, the similarities are remarkable. This implies that in general the regional hydrology shown on the military survey maps provides a proxy for the prehistoric and historic pre-regulation hydrology.

Dating the Lateral Migration of Meanders

In 2002, Tod Frolking and his students extracted a series of cores along a 300 m transect from the base of the Vésztő-Mágor tell to the pre-regulation Sebes-Körös River channel that flowed around this large tell (Gyucha et al. 2011:403–408; see also Chapter 2, this volume). Calibrated radiocarbon dates on wood samples from some cores and a diagnostic Árpádian Age (eleventh to thirteenth century AD) sherd found in another core revealed that the river slowly had been migrating southward since the tell was founded during the Middle Neolithic period. The results suggest that between 5600 cal BC and 1000 cal AD, the average migration rate of the river was only 1 m every 30 years (see Chapter 2, this volume). Late Neolithic and Early Copper Age sites with similar locations relative to pre-regulation meanders in the Körös River system suggest comparable migration rates.

This slow rate of lateral channel migration supports our model of a stable network of meanders flowing through the Körös River system during the Holocene. With these results, it is possible to describe the Early Copper Age hydrology of the study area at the regional, subregional, and micro-regional scales.

Early Copper Age Paleohydrology of the Study Area: The Regional and Subregional Scales

Based on paleohydrological characteristics, the study area can be divided into two regions: (1) the Körös region and (2) the Maros Fan. The Körös region can be subdivided into two subregions: (1a) the Körös–Berettyó Interfluve in the northern part of the study area (north of Szeghalom), between the Berettyó River and the northern floodplain of the Hármas-Körös River; and (1b) the Körös Valley in the southern section of the area (Figures 3.1 and 3.2).

The Körös–Berettyó Interfluve subregion

On the Dévaványa Plain in the Körös–Berettyó Interfluve, Holocene alluviums cannot be identified. Some of the paleochannels have been filled in and their courses are uncertain. The Csecseri Creek, stretching along the outskirts of Dévaványa and Szeghalom, is a typical example of this kind of Pleistocene paleochannel (Figure 3.5). Channel widths range between 100 and 400 m (the maximum width was more than 800 m at Dévaványa), with meander amplitudes between 2 and 6 km. These characteristics indicate a Pleistocene paleohydrology with large, high-energy rivers. Previous paleohydrological and geoarchaeological studies also noted this pattern (Molnár and Sümegi 2007; Papp 1969:274). Most of these large paleochannels do not fit into the Körös-Berettyó hydrological network. In the nineteenth century, Huszár (1985 [1823]:27) also expressed his doubts that the wide and deep reaches of the low-energy Berettyó River in the Nagy-Sárrét were recent channels, and we do not believe that these large paleochannels were active during the Early Copper Age.

Previous studies based on cores suggested that the Tisza River migrated back and forth across the northern periphery of the study area during the late Pleistocene. Following the most recent geological studies (Gábris and Nádor 2007; Nádor et al. 2007; Thamó-Bozsó et al. 2002), we suggest that the wide paleochannels of high amplitude that we encountered between the Körös and Berettyó Rivers were associated with the Pleistocene Tisza River. Two branches of the Tisza River may have crossed the region, and the western branch became the bed of the Berettyó River (Nádor et al. 2007). The eastern branch, which may be the Pakác-Fürjes Creek, might not have been active during the Holocene. Absolute dates on samples from alluvium in the outskirts of Dévaványa and Túrkeve suggest that the ancient Tisza River moved away from this area during the last glacial period (Nádor et al. 2007).

The second Habsburg military survey map indicates that the Csecseri Creek, the most representative paleochannel of the Dévaványa Plain, was a lake with altering water levels immediately before regulation and possibly during the entire Holocene period (Figure 3.3). The geoarchaeological investigations in the vicinity of Ecsegfalva outlined a similar process. At Kiri-tó (Lake Kiri), the stream was meandering in the early phase of the Würm glaciation. It was cut off during the late phase of the Würm glaciation and filled in gradually during the Holocene (Sümegi and Molnár 2007). During the Holocene, in the Körös–Berettyó Interfluve subregion, these Pleistocene paleochannels may have diverted some of the floodwaters of the Berettyó River. Only a few of these paleochannels became an active part of the Holocene hydrological network.

The Körös Valley subregion

South of the Körös–Berettyó Interfluve, the Körös Valley had different paleohydrological characteristics (Figures 3.1 and 3.2). The eastern portion of this subregion was composed of a fan-shaped system of paleochannels before regulation. However, there are fewer ancient river and stream courses from Köröstarcsa along the Hármas-Körös River. All the major paleochannels are relatively small meanders, 20–75 m wide, with small amplitudes (Figures 3.4 and 3.5). Flooding cut high banks and formed natural levees along the channels of these rivers during the Holocene.

A few wide and deep paleochannels with large amplitudes similar to those in the Körös–Berettyó Interfluve were identified at the northeastern edge of the subregion near Biharugra, in the west between Endrőd and Szarvas, and south of Békésszentandrás. These larger paleochannels may date to the late Pleistocene (Figure 3.2). They do not fit into the Holocene hydrology of the subregion and may be associated with the ancient Tisza River or other Pleistocene channels in the Körös Valley (Gábris and Nádor 2007:Figure 12; Láng 1960:35). Most Pleistocene river channels may have been buried under Holocene alluvial deposits. The only wide and deep paleochannels that are visible are located farther away from the active rivers.

It is more challenging to evaluate paleohydrological features in the southern edge of the Körös Valley and in the transitional zone between that subregion and the Maros Fan. During the Pleistocene, three ancient rivers could have migrated across this area. The northernmost branches of the ancient Maros River migrated along a southeast–northwest axis (Borsy 1990:243; Somogyi 1961:40). The eastern branch of the ancient Tisza may have flowed east–west (Gábris and Nádor 2007), and ancient branches of the Fehér-Körös and Fekete-Körös Rivers may have moved in from the southeast, after the ancient Tisza and Maros Rivers had migrated out of the area (Nádor et al. 2007). If that were the case, the Fehér-Körös and Fekete-Körös Rivers would have established their pre-regulation courses at the beginning of the Holocene. The possibility that active paleomeanders connected to the Kettős-Körös and Hármas-Körös Rivers existed during the Holocene along the southern periphery of the Körös Valley also makes evaluation of the paleohydrology of the subregion more difficult. Pleistocene paleochannels south and southwest of the Hármas-Körös and Kettős-Körös Rivers that were not active in the Holocene likely were created by the ancient Tisza and Körös. Paleochannels south of this area were formed by the ancient Körös River and/or the Maros River.

The northern Maros River fan

The Maros River alluvial fan did not have active channels during the Holocene (Figures 3.2 and 3.5). The ancient Maros River gradually moved south and had established its current course by the end of the Pleistocene. Several Pleistocene paleochannels on the fan could have been filled with water during Körös River floods for shorter periods of time. With the rise of groundwater levels and heavy rainfall, short-lived, shallow ponds and lakes may have formed on the fan (Somogyi 1969a).

The soils of the Körös region and the Maros Fan also are quite different. In the Körös Valley and the Körös–Berettyó Interfluve, seasonal or perennial inundations and changes in groundwater levels influenced soil formation processes. In those subregions, hydromorphic soils formed during the Holocene. In the perennial wetlands, deep meadow clays and peat formed, while at higher elevations, sodic soils developed. On the largely flood-free Pleistocene lag surfaces in the Körös region, chernozem soils could have occurred (Sümegi 2000:14). On the northern Maros Fan, zonal soils that formed on redeposited loess were influenced by climate and vegetation cover, and chernozems predominate. Closer to the Fehér-Körös River, the influence of groundwater can be seen in the soil formation processes.

Ancient marshlands

Prior to river regulation and field drainage programs, large marshlands also existed in the study area (Figure 3.6). Tectonic processes, rainfall, and flooding cycles led to the inundation of these low-lying areas.

The Sárrét marshes are composed of two subsidence basins. They were the largest marshlands in the study area. The southern basin is called the Kis-Sárrét (Little Mud Meadow), while the northern is the Nagy-Sárrét (Great Mud Meadow; Figures 3.1 and 3.6). The Nagy-Sárrét extends into the Körös–Berettyó Interfluve subregion as far west as Karcag, Püspökladány, and Nádudvar. It was fed by the waters of the ancient Berettyó River. Before regulation, the area of the Nagy-Sárrét exceeded 800 km^2.

The Kis-Sárrét marsh lies between the ancient Szamos River on the north and the alluvial fans of the Sebes-Körös River on the south. It consisted of two marshlands, one located around Komádi and Csökmő, and another near Füzesgyarmat and Furta. The roughly 500 km^2 of the Kis-Sárrét marsh was flanked by a Sebes-Körös paleomeander running in the direction of Biharugra, Okány, and Vésztő. Based on the estimated amount of accumulated peat, it was assumed that the Kis-Sárrét and Nagy-Sárrét marshes formed during the Holocene (Papp 1960, 1969). However, recent data indicate that some near-surface sediments date to the Pleistocene (Sümegi and Molnár 2007).

According to the first military survey maps of the Habsburg Empire, as well as Huszár's map from 1821, parts of the pre-regulation Dévaványa Plain in the Körös–Berettyó Interfluve subregion were seasonally or perennially inundated wetlands, similar to contemporary areas around the Kiri-tó at Ecsegfalva. Fluctuation in groundwater levels might have triggered expansion or contraction of these wetlands (Gillings 2007). Other wetlands may have extended from the Kis-Sárrét to the Fekete-Körös River and between the Fekete-Körös and Fehér-Körös Rivers. This approximately 300 km^2 area included the Gyánti meadow (57 km^2), the Fási meadow (129 km^2), and the Péli and Gyulavári meadows (115 km^2). These wetlands were fed by branches of the Fekete-Körös and Sebes-Körös Rivers. The area was called Zarkad Lacus (Lake Sarkad) on Hevenesi's 1689 map, and according to other written records, this lake existed until the end of the eighteenth century.

North of the Hármas-Körös River and south of the Dévaványa Plain, there was a deep Pleistocene basin west of Körösladány; it was called Pósár on the Habsburg military survey maps. This marsh was enclosed by branches of the ancient Tisza River (Gábris and Nádor 2007:Figure 12) and fed by the Berettyó River and the Hármas-Körös

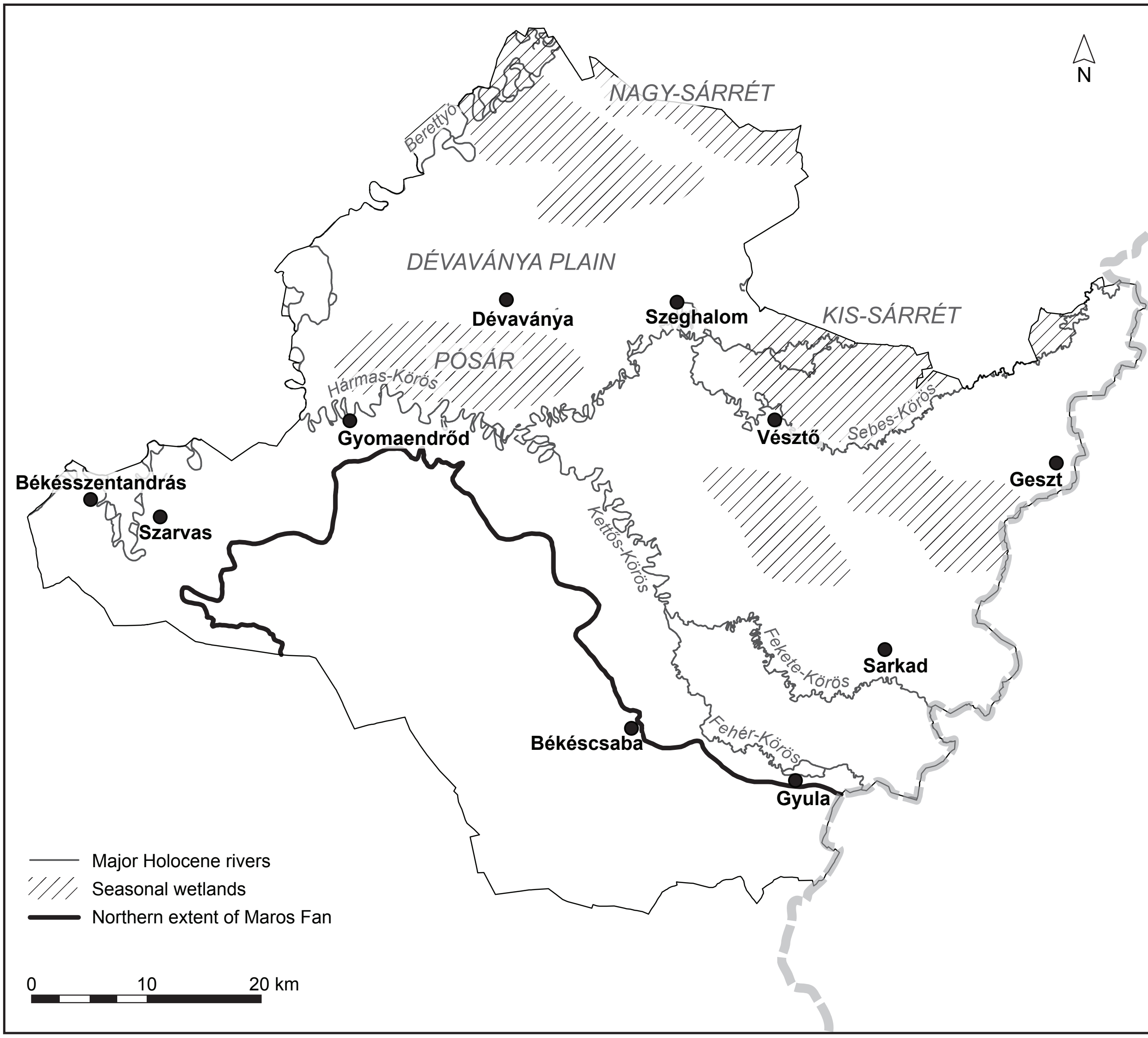


Figure 3.6. Marshlands identified on early maps of the study region. The Nagy-Sárrét and Kis-Sárrét marshes extend beyond the limits of the study area. *Figure by Jill Seagard and Paul R. Duffy.*

River during the Holocene. It covered an area of at least 86 km^2. In addition to these marshlands, smaller wetlands that formed after large floods can be identified in the study area around Békéscsaba, Gyula, and Doboz.

Early Copper Age Paleohydrology of the Study Area: The Micro-Regional Scale

Within the reconstructed regional hydrology, it is possible to distinguish 13 micro-regions in the study area (Gyucha 2015).

Micro-region 1 is bordered by the Hármas-Körös River on the north, the western margin of the study area, the Maros Fan on the south, and a section of a stream running along the floodplain of the Hármas-Körös River on the east. The only active major channels in this micro-region during the Holocene were the Hármas-Körös meander between Békésszentandrás and Szarvas, and the Cigány Creek to the east. In a 10 km-wide area between the Cigány Creek and another, unnamed tributary of the Hármas-Körös River, only one paleochannel is likely to be of Pleistocene age. This channel may have connected to the Pleistocene Kondoros Creek, which flowed into the Cigány Creek. Segments of other Pleistocene paleochannels, possibly remnants of the ancient Tisza and Körös Rivers, were also identified in the micro-region. Settlements from the Neolithic period to the Middle Ages were found along the active Körös meanders, but from the Late Bronze Age on, sites were also located near Pleistocene paleochannels.

Micro-region 2 is situated between the Kettős-Körös River, the Hármas-Körös River, and the northern edge of the Maros Fan. Its southeastern border is at the pre-regulation confluence of the Fehér-Körös and Fekete-Körös Rivers. In the west, there is a south–north section of a paleochannel along the Hármas-Körös River. There are only two, filled-in paleochannels in the micro-region, which merged and also joined the Kettős-Körös and Hármas-Körös Rivers. From the Early Neolithic to the Middle Ages, most settlements were established along these streams, while a few were located along the Kettős-Körös and Hármas-Körös Rivers.

Micro-region 3 is located between the Fehér-Körös River and the edge of the Maros Fan, and it extends northward to the pre-regulation confluence of the Fehér-Körös and Fekete-Körös Rivers. No definite Holocene paleochannels were connected to the Körös River system. Several possible Pleistocene paleochannels may be related to the ancient Maros and Körös Rivers. Before the Late Bronze Age, the area was very sparsely populated, but after that time, settlements were established across the micro-region.

Micro-region 4 is enclosed by the Berettyó River on the west, the Hármas-Körös River on the south, and the northern and eastern margins of the Pósár marshland (Figure 3.6). In addition to tributaries of the Hármas-Körös and Sebes-Körös Rivers, the Köles Creek, which connected the Berettyó River to the Hármas-Körös River, was the most prominent paleochannel during the Holocene. The Tarcsány Creek, which might have flowed in a Pleistocene channel, joined this paleochannel. With the exception of a small, second- to fourth-century AD Sarmatian settlement, no archaeological sites were located away from the Hármas-Körös River.

Micro-region 5 is bordered by the Kettős-Körös River to the west–southwest, the Sebes-Körös River on the north, the Guzsaly Creek on the northeast, the Büngösd Creek on the southeast, and the Fekete-Körös River on the south. Prior to river regulation, the Büngösd Creek, which connected the Fekete-Körös River with the Kettős-Körös River, was a significant meander. Northeast of the Büngösd Creek, along the Malom and Guzsaly Creeks, a complex local hydrology with a series of low-amplitude meander loops developed during the Holocene. The higher banks of the older branches of the Büngösd Creek, as well as the banks of the Malom and Guzsaly Creeks, were occupied from the earliest period of the Neolithic. Low banks along the younger channel of the Büngösd Creek and the low area between the Büngösd and the main Kettős-Körös River channel were only sparsely populated in prehistory.

Micro-region 6 is situated between the modern Fehér-Körös and Fekete-Körös Rivers and extends northward to the pre-regulation confluence of those rivers. In its eastern portion, a very complex local hydrological system was noted. To the west, a few filled-in paleochannels that once connected the rivers are discernible. In the northern part of the micro-region, several branches of the Fehér-Körös River (for example, Kászmány Creek, Medves Creek) are visible. The banks of the water channels in the middle and western portions of the micro-region were inhabited from the Neolithic to the Middle Ages. However, archaeological sites in the eastern, complex local hydrological system date only to the Late Bronze Age and later periods.

Micro-region 7 is located southwest of the Kis-Sárrét marsh and bordered by the Sebes-Körös River on the north and northwest. The Köles Creek is on the northeast and the Guzsaly Creek is on the southwest border. In the Holocene, the southern branch of the Sebes-Körös River flowed across the area. The Dió Creek meander was along the southwestern side of the river. There is a 3 km-wide lowland between the Dió Creek and the Guzsaly Creek. This may have been a perennially wet area before regulation. The banks of these channels, particularly those of the Dió Creek, were occupied from the initial phase of the Neolithic to the Middle Ages.

Micro-region 8 is enclosed by the Fekete-Körös River on the south, the Büngösd Creek and Malom Creek to the west, and the Köles Creek on the north. A complex system of narrow channels with low-amplitude meanders developed here. The most prominent paleochannels in the area were the Gyepes Creek, the Fás Creek, and the Fekete Creek. The paleohydrological reconstruction indicates that prior to regulation there was a marshland fed by branches of the Fekete-Körös River in this micro-region. It was depicted on the first Habsburg military survey map as a small wet area. However, some decades later, Huszár noted that this entire micro-region was about to become marshy again (Huszár 1985 [1823]:37–38). The micro-region was unoccupied before the middle of the Early Bronze Age, but from that time on, the banks of the meanders were inhabited regularly.

Micro-region 9 is bounded by the southern extension of the Kis-Sárrét marsh and the Sebes-Körös River. North–northeast of Vésztő, smaller streams branched out from the Sebes-Körös River. Along the northern edge of the micro-region, the Sebes-Körös channel, which later served as the main course of the regulated riverbed, flowed across the marshland. From Vésztő to Körösújfalu, between these two Sebes-Körös River branches, a wide, northeast–southwest paleochannel (probably dating to the Pleistocene) is recognizable. Its elevated banks were densely populated from the Early Neolithic to the Middle Ages. The vast majority of known archaeological sites in the Kis-Sárrét marshlands are located along this water channel.

Micro-region 10 is bordered by the Köles Creek on the southwest, the Sebes-Körös River on the northwest, and the edge of the study area on the east. Geomorphologically, the micro-region is marked by several wide networks of southeast–northwest flowing streams with high banks (including the Köles Creek) along the southwestern margin of the micro-region and 8–10 km to the north, where the Korhány Creek flowed. Both networks were associated with the Sebes-Körös River, but there might not have been any active channels between the two stream networks or northeast of the Korhány Creek during the Holocene. Here, the paleochannel sections might date to the late Pleistocene. Most settlements from the Neolithic to the Middle Ages were established on the banks of the active rivers and streams.

Micro-region 11 is enclosed by the Pósár marsh on the southwest, the Pakác-Fürjes Creek to the northwest, and the Kis-Sárrét marsh and the border of the study area on the east–southeast. The Pakác-Fürjes Creek channel that linked the Berettyó-Akasztó and the Sebes-Körös River, and separated the Kis-Sárrét and Nagy-Sárrét marshes, may have been formed by a branch of the ancient Tisza River. The many, broad Pleistocene paleochannels in this micro-region have large meander amplitudes. The majority of them might have been associated with the ancient Tisza River. However, in the southeastern part of the micro-region, several Holocene watercourses connected to the Kis-Sárrét marsh. Geomorphologically, the micro-region is in the transitional zone between the Körös Valley and Körös–Berettyó Interfluve subregions. These branches of the Sebes-Körös River were occupied from the earliest phase of the Neolithic to the Middle Ages.

Micro-region 12 is bounded by the Pakác-Fürjes Creek on the southeast, the northern margin of the Pósár marsh on the south, the Berettyó River on the west and northwest, and the Berettyó-Akasztó on the northeast. The Berettyó River, which occupied a Pleistocene riverbed (possibly the western branch of the ancient Tisza River), might have been the only active watercourse during prehistory. Wide paleochannels with huge meander loops and high banks likely are associated with the late Pleistocene Tisza River. These meanders were inactive in the Holocene. The longest is the Csecseri Creek, which flowed through the Gabonás Creek up to the Pakác-Fürjes Creek. The Csecseri Creek could have linked the ancient Berettyó River with the eastern branch of the ancient Tisza River. Before regulation, the micro-region was perennially wet and seasonally inundated. In the Holocene, the floods of the Berettyó River fed the old oxbow lakes. From the Early Neolithic to the Middle Ages, most settlements were located on the high banks of the Csecseri Creek and along the Berettyó River. Very few archaeological sites were recorded in the inner part of the micro-region.

Micro-region 13 is bounded by part of the Nagy-Sárrét marshland, the area between the Berettyó-Akasztó and the northern margin of the study area. The micro-region was completely unoccupied during the Early Copper Age.

Conclusions

Using historical and modern topographic maps, aerial photos, and archaeological data, the earlier reconstructions of the Holocene hydrology of the Körös region have been updated and modified (Gyucha et al. 2011). This GIS-based research and records from geological cores both indicate that the hydrological systems that developed during the early Holocene were stable and did not undergo significant changes until large-scale water regulation works were completed in the nineteenth century. When the reconstructed paleohydrology is compared to settlement data, it shows the continuous occupation of the same meanders for at least 8,000 years (Figure 3.5). In addition to the rivers and streams, the majority of the wetlands also might have formed at the beginning of the Holocene.

In the flat, low-energy environment of the study area, only gradual, long-term changes could have occurred, mostly at the local scale. The pre-regulation hydrology shown on historic maps may serve as a proxy for conditions during the Early Copper Age. Some of the meanders did alter their courses and create oxbow lakes during the mid-Holocene, but significant climatic changes have not been documented in this region and did not result in major landscape modifications or substantial transformations in the river network.

In contrast to the complex paleohydrology of the Körös Valley subregion, there might not have been any active water channels in the inner portion of the Körös–Berettyó Interfluve during the Early Copper Age. In this subregion, lakes formed in abandoned late Pleistocene Tisza River channels. The impermeable soils, high groundwater levels, and Berettyó River floods allowed the lakes to persist in the region until canalization and drainage programs eliminated them.

According to the settlement data from the study area, sites were established on higher banks of active channels and along oxbow lakes throughout prehistory. These locations were favored before, during, and after the Neolithic–Copper Age transition. This pattern did not change until the first half of the Iron Age, when significant numbers of settlements appeared for the first time on the Maros Fan (Gyucha 2001). This was a time when population in the Körös region seems to have decreased. But if animal herd size and herding economies were expanding at that time, the grasslands of the Maros Fan would have attracted Middle Iron Age pastoralists, even if they were avoided by Neolithic and Copper Age agropastoralists.

The refined Holocene paleohydrological model for the Körös region provides an environmental context for the Early Copper Age Vésztő-Bikeri and Körösladány-Bikeri sites. The model is a useful tool for understanding how particular hydrological and landscape features influenced local and regional settlement decisions. Studies of these environmental characteristics also can help us gain a better understanding of the economic and social organization of Early Copper Age communities in this region.

Chapter 4

Archaeological Surface Collections

Richard W. Yerkes, William A. Parkinson, and Attila Gyucha

The way early agricultural groups organized themselves spatially at different geographic scales changed significantly during the Neolithic–Copper Age transition. Late Neolithic sites throughout the Körös region tended to be clustered in more or less discrete groups around a tell or a large horizontal settlement along specific branches of the Körös River system, but Early Copper Age settlements were more evenly dispersed across the landscape, exhibiting more diffuse patterns without focal sites (Figures 4.1–4.2; Gyucha 2009, 2015; Gyucha et al. 2004, 2009, 2013, 2014; Parkinson 2002, 2006a; Parkinson et al. 2004a, 2004b, 2010b; see also Chapter 3, this volume). These regional changes in settlement patterns correlated with fundamental shifts in settlement organization. Previous research on the Great Hungarian Plain concluded that the Early Copper Age Tiszapolgár period was characterized by small and ephemeral villages and hamlets (e.g., Bognár-Kutzián 1963, 1972), but the structure and use of these settlements remained largely unknown.

The regularly plowed fields that constitute the vast majority of the Körös region offer excellent opportunities for archaeological surface surveys, and systematic and controlled collections became integral parts of the Körös Regional Archaeological Project. During the surface collection campaigns, we sought to collect Early Copper Age ceramic samples for stylistic analysis to explore regional-scale interaction and integration, and to acquire high-resolution data about settlement size, layout, and activity patterns through surface artifact distributions.

Systematic Surface Collections by the Körös Regional Archaeological Project

Settlement Patterns, Integration, and Interaction

The first phase of fieldwork by the project in the study area was part of Parkinson's dissertation research (Parkinson 1999, 2006a, 2006b). In 1998, a small survey team revisited and collected numerous Early Copper Age sites throughout the Körös region that had been identified during the Archaeological Topography of Hungary (Magyarország Régészeti Topográfiája, or MRT) program (Ecsedy et al. 1982; Jankovich et al. 1989, 1998; Szatmári in prep.; see also Chapters 1 and 2, this volume). While the MRT program had been concerned with site identification, classification, chronology, and documentation, the Körös Regional Archaeological Project team employed systematic, controlled surface collection techniques that had been developed in the Aegean and the United States (e.g., Davis et al. 1997). In addition to observations regarding settlement layout and organization, an elaborate stylistic analysis was applied to study integration and interaction across the Körös region.

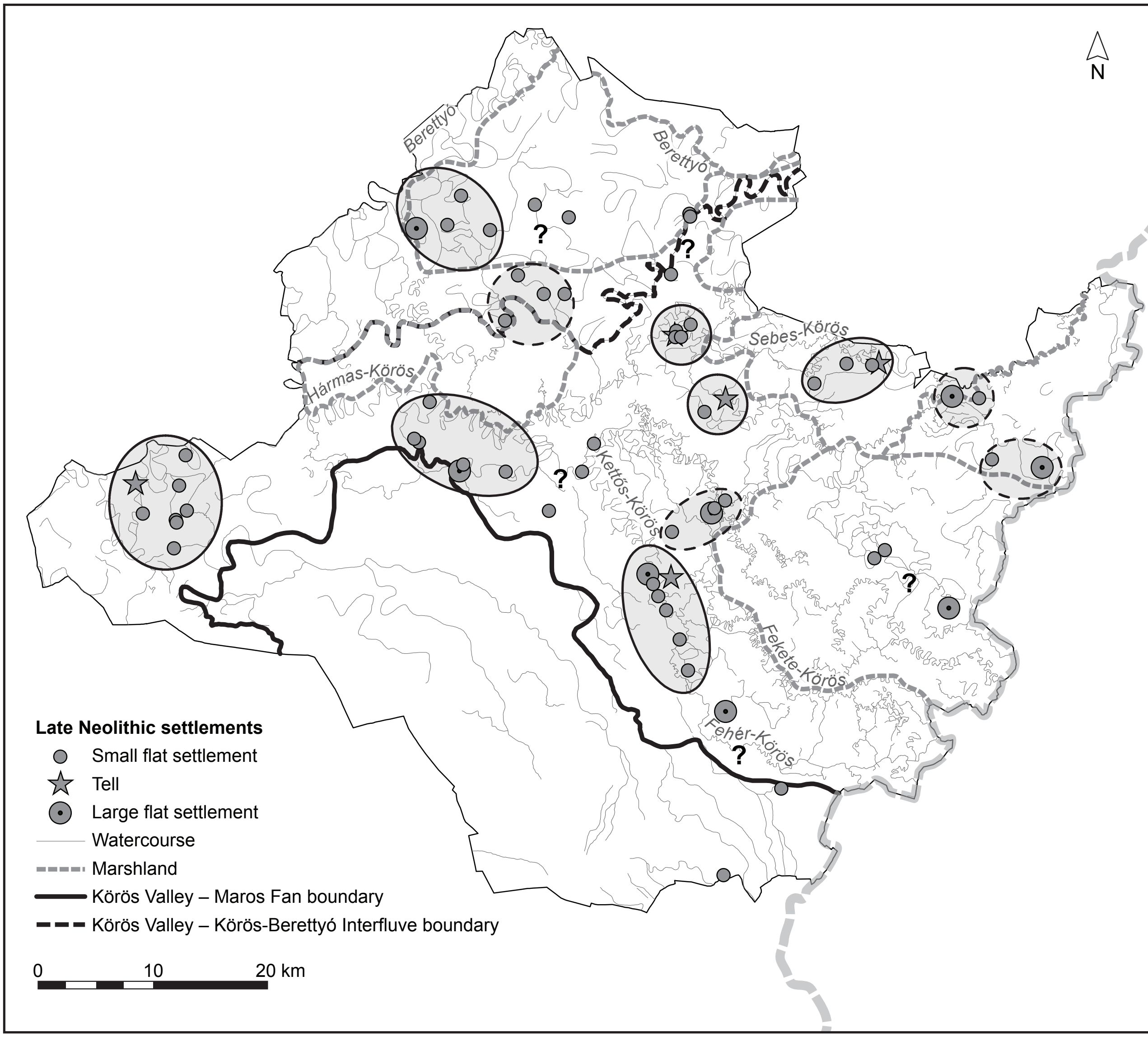


Figure 4.1. Late Neolithic sites and settlement clusters in the study area. *Figure by William A. Parkinson, Attila Gyucha, and Jill Seagard.*

Parkinson's (2002, 2006b) stylistic analysis demonstrated that although ceramic style was remarkably homogeneous across the Great Hungarian Plain by the Early Copper Age, the distribution of some highly visible stylistic attributes on Tiszapolgár ceramics, such as the frequency of incised decoration, exhibited a distinct spatial pattern, decreasing in frequency from west to east in the Körös River basin. Parkinson argued that these stylistic patterns indicate that the rigid social boundaries that were actively maintained during the Late Neolithic had become more permeable by the Early Copper Age. This general trend toward increasing interaction throughout the entire study area also seems to have been associated with a general tendency toward a less complexly structured system of social integration that may have been related to an increase in residential mobility during the Early Copper Age. Settlement pattern analyses at the regional scale suggested that although several Late Neolithic social units persisted into the Copper Age, the boundaries between those units changed substantially between the two periods (Gyucha 2015:figures 4.1-4.2).

During his dissertation research, Parkinson (2006a) collected surface samples using the "dog leash"

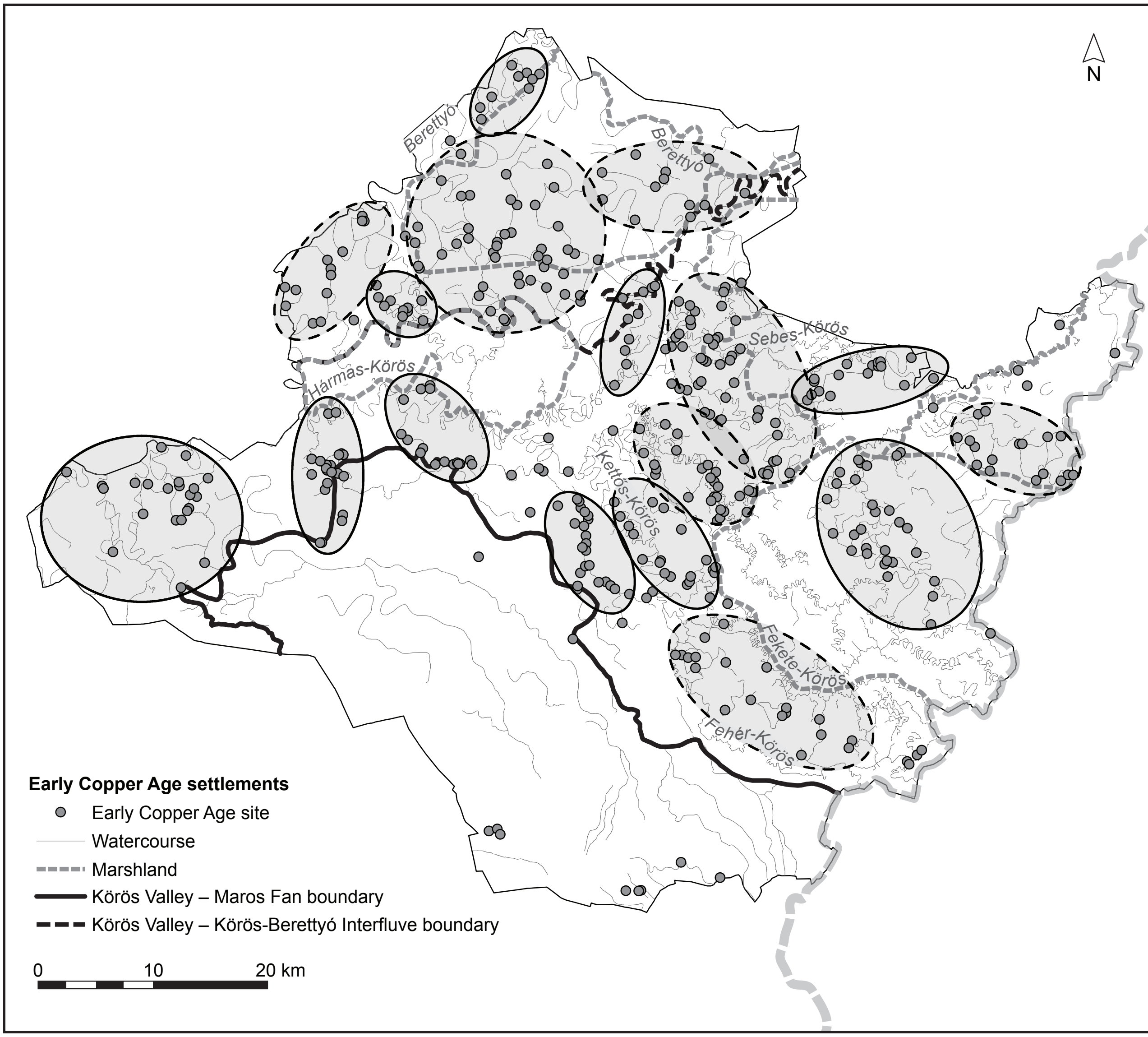


Figure 4.2. Early Copper Age sites and settlement clusters in the study area. *Figure by William A. Parkinson, Attila Gyucha, and Jill Seagard.*

collection method: tethering a measuring tape to the ground and collecting everything within a designated circular area. This method proved useful for estimating the size of the Early Copper Age settlements and in some cases for identifying activity areas (see below). At Körösladány-Bikeri and Okány-Futás, a different method was also employed during the second phase of surface investigations. To improve the resolution of the artifact density patterns within the sites and to establish clear spatial relationships between subsurface geophysical anomalies, soil chemistry patterns, and surface finds, gridded archaeological surface collections in 5 x 5 m or 10 x 10 m grids were laid out, and then all artifacts in each grid square were collected, recorded, and analyzed. The results of these "vacuum collections" then were integrated with geophysical and soil chemistry survey data in a GIS platform that produced distributions of anomalies, phosphate concentrations, and artifact densities associated with different types of subsurface features and activity areas (Gyucha et al. 2009; Parkinson et al. 2010b; Sarris et al. 2004; Yerkes et al. 2007; see also Chapters 5 and 6, this volume). We integrated these different lines of evidence to develop more precise characterizations of the size and internal organization of these Early Copper Age settlements. Gridded surface collections were not conducted at Vésztő-Bikeri.

Settlement Layout and Use

Three Early Copper Age sites, Vésztő-Bikeri, Körösladány-Bikeri, and Okány-Futás, were selected for systematic surface collection during the Körös Regional Archaeological Project (see Figure 1.2).

Vésztő-Bikeri

In 1998, as part of Parkinson's dissertation research, 11 dog leash collection units, each 5 m in diameter and measuring 78.5 m^2, were collected at Vésztő-Bikeri (Figure 4.3B). The field recently had been plowed and disked, offering excellent surface visibility, and four features were identified based on concentrations of cultural material on the surface. Surface Feature 1 was a scatter of human bone, Surface Feature 2 was a concentration of animal bones, and Surface Features 3 and 4 were concentrations of burned daub and Tiszapolgár ceramics that seemed to mark the locations of structures. Most cultural material collected from the surface was concentrated in a 0.4 ha area in the center of the site, and the maximum extent of diagnostic sherds covered about 0.7 ha. The highest surface density was identified in unit SE15 (Figure 4.3B). All the diagnostic ceramics in the surface collection were identified as Tiszapolgár types, except one Árpádian Age

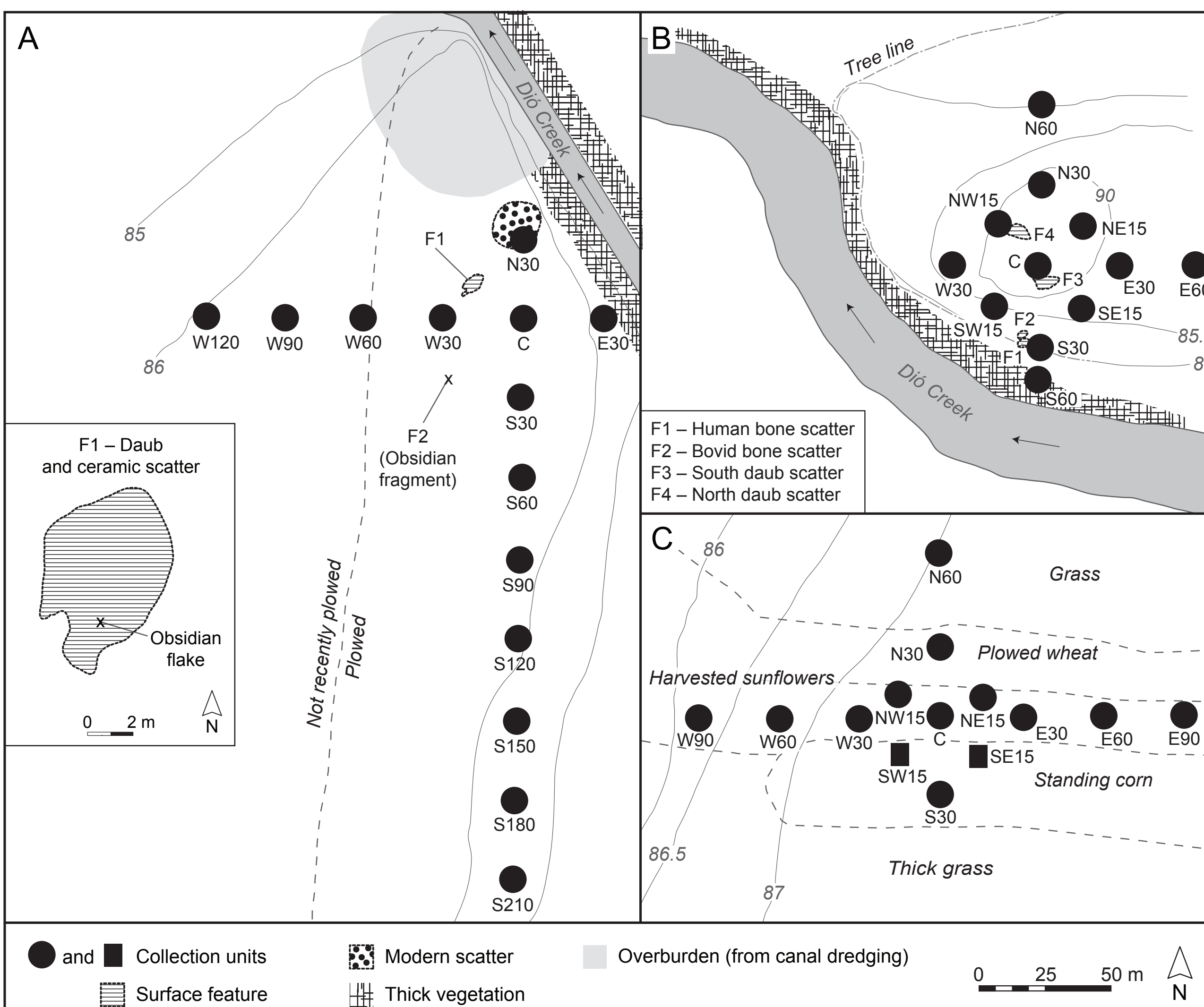


Figure 4.3. Surface collection units at three Early Copper Age sites in 1998. A: Körösladány-Bikeri; B: Vésztő-Bikeri; C: Okány-Futás. *Figure by William A. Parkinson and Jill Seagard.*

(eleventh to thirteenth century AD) ceramic and one modern sherd (Ecsedy et al. 1982:188; Parkinson 2006a). Thus Vésztő-Bikeri seemed to be a single-component Tiszapolgár settlement.

The two burned daub and ceramic concentrations (Surface Features 3 and 4; Figures 4.3B and 4.4) were sub-rectangular and included a number of Early Copper Age sherds and numerous large burned daub fragments. The human remains (Surface Feature 1; Figure 4.3B) consisted of the lower limbs of a skeleton that had been plowed up. The animal bones may have come from a midden located at the edge of the Early Copper Age settlement. Horse remains found on the surface likely date to a more recent period. Freshwater shell, loom weights, and a net sinker were also collected from the 1998 sample units (Parkinson 2006a).

In 2000, a 2 x 2 m test excavation unit (Block 2) was placed where the Surface Feature 3 daub and ceramic scatter was located. This test unit was expanded in subsequent years. A burned wattle-and-daub longhouse was exposed below the plowzone (Feature 4/14; see Chapters 7 and 8, this volume). Another test excavation unit (Block 3) near Surface Feature 4 (Figure 4.3B), the northern daub and ceramic scatter, exposed the remains of another longhouse (Feature 5; see Chapters 7 and 8, this volume). Excavations in Block 4, a 2 x 2 m unit about 20 m east of the animal bone concentration (Surface Feature 2) and near surface collection unit SE15 (Figure 4.3B), revealed part of a ring midden surrounding the Vésztő-Bikeri village (see Chapters 7 and 8, this volume); no test excavation units were placed above the animal remains (Surface Feature 2) or the human remains (Surface Feature 1; Figure 4.3B).

Körösladány-Bikeri

At Körösladány-Bikeri, 5 m diameter dog leash units (78.5 m^2 circular collection units) were collected at 30 m intervals from the apparent site center. At this site, in a plowed field with moderate surface visibility, 13 units were collected (Figure 4.3A). Most material was

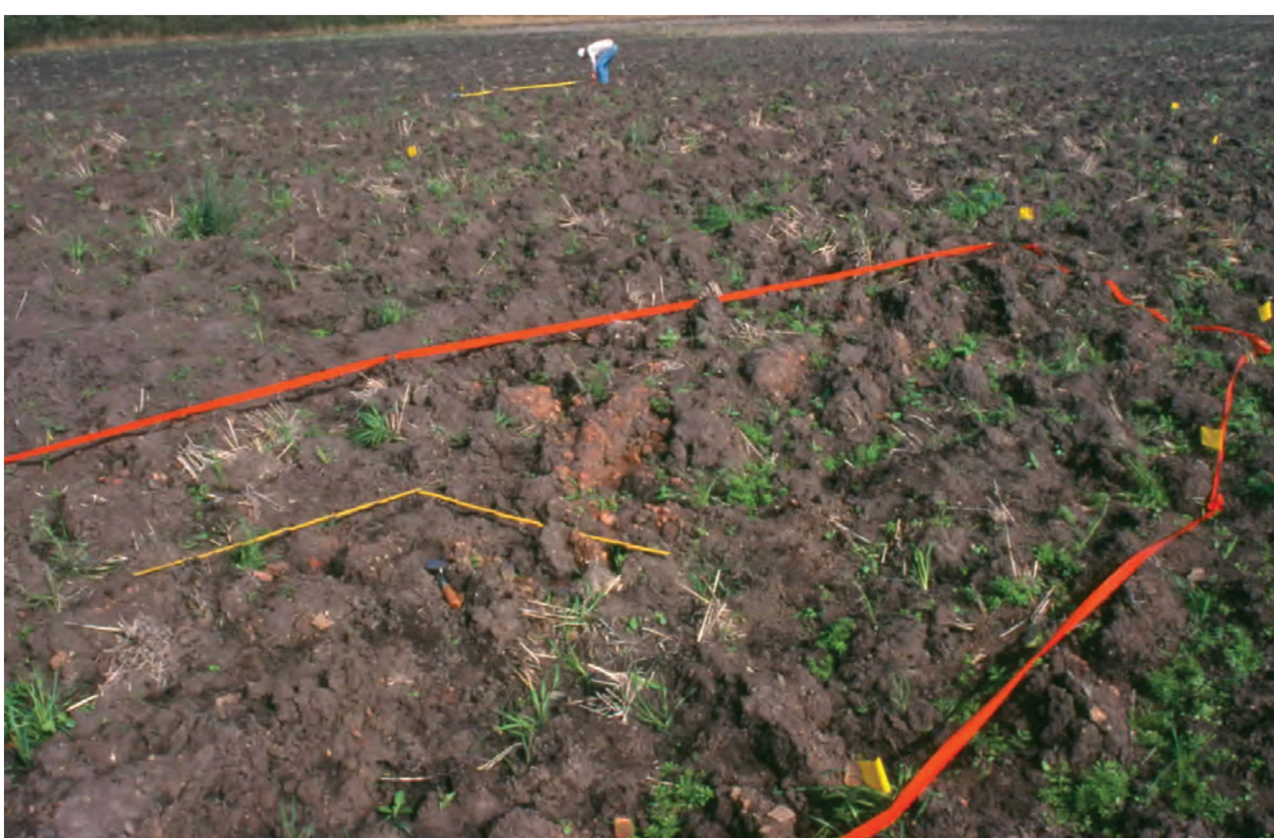


Figure 4.4. Surface Feature 4 at Vésztő-Bikeri during collection in 1998, showing a concentration of daub and ceramics on the plowed surface. *Figure by William A. Parkinson.*

Figure 4.5. Gridded, intensive surface collection at Körösladány-Bikeri in 2005. *Figure by Attila Gyucha.*

found in a core area of about 0.5 ha, but less dense surface scatters extended 210 m south and 120 m west of the center. Modern disturbances and spoil from dredging the canal were visible in the north. Surface Feature 1 (Figure 4.3A), a burned daub and Tiszapolgár ceramic scatter that seemed to mark the location of a structure, was collected separately. Surface Feature 2 (Figure 4.3A), a large obsidian fragment, was found about 30 m southwest of the Surface Feature 1 artifact scatter. Of the 140 diagnostic ceramics from the collection units, 90 percent were Tiszapolgár types, but a few sherds were assigned to the Middle Copper Age Bodrogkeresztúr culture (circa 4000–3500 cal BC), the Late Bronze Age Gáva culture (circa 1300–900 cal BC), the Sarmatian period (second to fourth century AD), and the Árpádian Age (Ecsedy et al. 1982:206; Parkinson 2006a; Parkinson et al. 2004b). Two chert and two obsidian artifacts were collected, along with grinding stone fragments and a ceramic spindle whorl. In 2001, a pair of 2 x 2 m test excavation units (Blocks 1 and 2) were placed near the Surface Feature 1 daub and ceramic scatter (see Chapter 7, this volume), but no features were identified below the plowzone.

The results of the 1998 surface collections at Körösladány-Bikeri suggested intact subsurface features, but the surface artifact distribution patterns were not as distinct as they were at Vésztő-Bikeri (see below). In 2005, gridded surface collections were conducted in 5 x 5 m grid units covering an area of 5,350 m^2 (Figure 4.5), and geophysical and soil chemistry surveys were carried out to complement the surface artifact distribution patterns (see Chapters 5 and 6, this volume). These results were used to identify possible subsurface features at Körösladány-Bikeri that would be the focus of subsequent excavations. A total of 1,495 sherds were collected during the gridded survey at Körösladány-Bikeri, with an average sherd density of 0.28 sherds per 1 m^2 (Figure 4.6A). Average sherd density by weight was 2.59 g per 1 m^2.

The surface distribution of daub fragments from the gridded surface collections complements the pattern of ceramic density (Figure 4.6B). The average daub densities (by weight) at Körösladány-Bikeri were 3.69 g per 1 m^2. Later excavations showed that Late Bronze Age and Sarmatian pits had been dug through the Early Copper Age layers at the site (see Chapter 7, this volume), and the

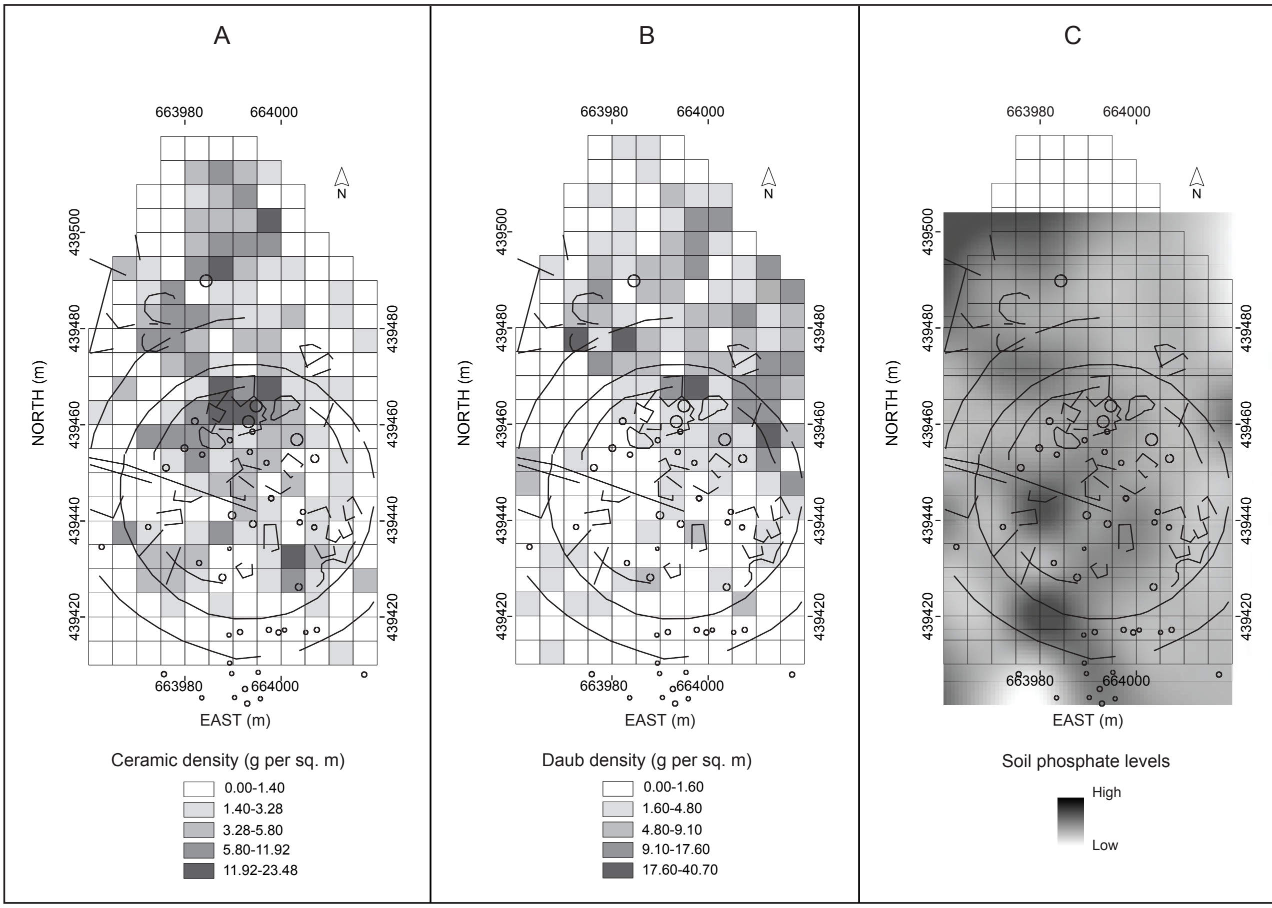


Figure 4.6. Map of Körösladány-Bikeri showing the results of gridded surface collections and soil phosphate survey overlain with magnetic anomalies. A: Ceramic density; B: Daub density; C: Soil phosphate levels. *Figure by William A. Parkinson and Jill Seagard.*

sherds and daub that were dug up by the later occupants created a higher concentration of Early Copper Age artifacts on the surface in some areas (Horobik 2008). As a result, the highest surface densities in the gridded surface collection units did not correlate perfectly with subsurface features at Körösladány-Bikeri (Figure 4.6; Parkinson et al. 2010b).

Okány-Futás

Okány-Futás is located approximately 10 km southeast of Vésztő-Bikeri on a small rise near an abandoned meander of the Sebes-Körös River (see Figure 1.2). Ecsedy et al. (1982:136) collected daub and Tiszapolgár culture artifacts from the site. In 1998, 14 sample units were collected from small fields covered with crops or grass and varying surface visibility (Figure 4.3C). In the standing corn, two rectangular 10 m^2 units were collected among the cornstalks, since the dog leash method could not be employed. Most cultural material was concentrated near the center of the site in a 0.21 ha area, but a dispersed scatter of cultural material covered about 0.6 ha on the low ridge (Parkinson 2006a:112–13; see also Chapters 5 and 6, this volume). The majority of diagnostic sherds date to the Early Copper Age, but some historic material (Migration period, fifth and sixth centuries AD) also was found on the surface. Obsidian and chert flakes, grinding stone fragments, and a pierced stone celt also were collected.

Gridded surface collections at Okány-Futás in 2006 included 171 grid units (10 x 10 m squares; Figure 4.7). Crops of different heights were standing on the small fields (wheat in the north, corn in the middle, and alfalfa in the south and east; see Figure 4.3C), resulting in varying degrees of visibility. Geophysical survey and coring for soil chemistry samples were conducted using the same grid system (see Chapters 5 and 6, this volume). In addition to several Migration period and modern sherds, as well as a concentration of recent material in the eastern

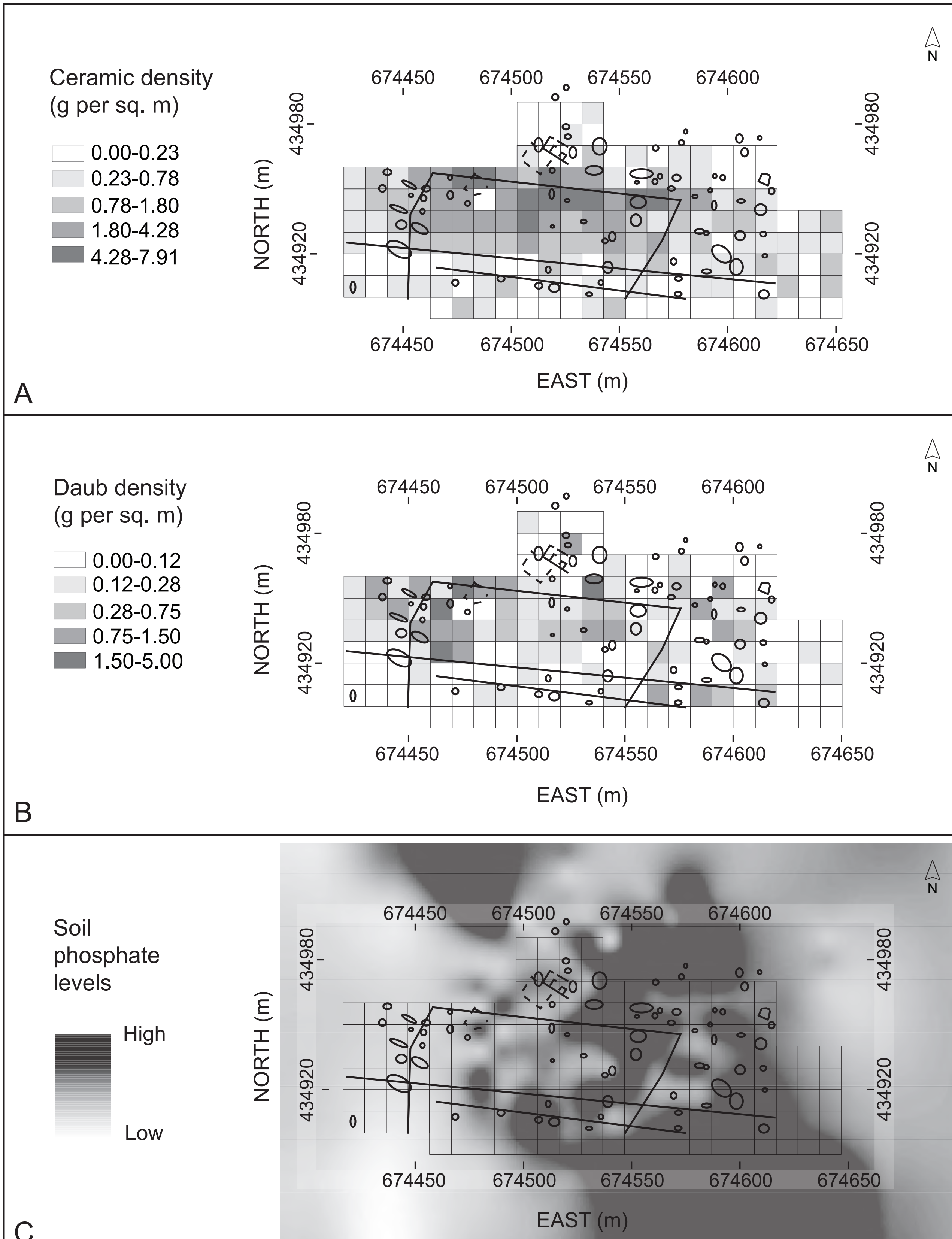


Figure 4.7. Map of Okány-Futás showing the results of gridded surface collections and soil phosphate survey overlain with magnetic anomalies. A: Ceramic density; B: Daub density; C: Soil phosphate levels. *Figure by William A. Parkinson and Jill Seagard.*

part of the site, the gridded surface collections produced a low-density scatter of Early Copper Age pottery and daub that extended over an area of about 100 x 40 m along the low, southwest–northeast ridge (Figure 4.7). A total of 3,058 sherds were collected from an area of 17,100 m^2. The overall ceramic density in this survey was 0.18 sherds per 1 m^2 (Figure 4.7A). Average sherd density by weight was 1.12 g per 1 m^2. These values are about half the densities recorded at Körösladány-Bikeri.

Daub density at Okány-Futás averaged about 0.2 g per 1 m^2, also much lower than at Körösladány-Bikeri (Figure 4.7B). Distributions of ceramics and daub were similar across the Okány-Futás site, with the exception of an area in the north–central part of the grid where the density of daub was high but ceramic density was low. This location is associated with a rectilinear anomaly identified during the geophysical survey that may mark the location of a longhouse (see Chapter 6, this volume). Two other rectangular anomalies were recorded during the geophysical survey, but the ceramic and daub densities at these locations were low (Figure 4.7; see Chapter 6, this volume).

Variations in Early Copper Age Settlement Organization

The excavated villages of Vésztő-Bikeri and Körösladány-Bikeri are located at the confluence of an abandoned Sebes-Körös paleomeander and a smaller paleochannel, the Dió Creek, into which a modern drainage canal was dug. The sites were established on both sides of the Dió Creek only 70 m apart, approximately 2 km south of the multicomponent tell at Vésztő-Mágor (see Figures 1.2–1.3; Hegedűs and Makkay 1987; Makkay 2004). Subsequent geophysical investigations and excavations identified fortifications at both villages, with concentric circular ditches accompanied by an innermost palisade with deep postholes (Gyucha et al. 2014; Parkinson et al. 2004a, 2010b; Sarris et al. 2004; Yerkes et al. 2007; see also Chapters 6 to 8, this volume).

The vast majority of Early Copper Age surface artifacts were distributed within the fortifications at both Bikeri sites. The patterns show that several houses might have been located in the central areas, with possible other features, such as storage facilities and workshops. The zone immediately surrounding the center might have consisted of ring middens, whereas surface material occurs generally in small numbers near the peripheries; this pattern is less clear in the northern section of Körösladány-Bikeri, where ceramics dated to later periods were found in greater numbers. The small amounts of Tiszapolgár sherds collected outside the perimeter of the circular ditches at the Bikeri sites indicate that either particular activities were conducted or gardens were located in close proximity to the villages. Similar settlement layouts were identified by Gyucha (2015) at numerous small Early Copper Age sites across the Körös region during his dissertation fieldwork.

The settlement layout at Okány-Futás differs significantly from the Bikeri villages. Based on the surface artifact densities and the geophysical survey, the Okány site seems to represent a small unfortified hamlet where only one building might have been used at a time and where fewer people lived for a shorter time than at Körösladány-Bikeri and Vésztő-Bikeri, which both seem to have been more substantial villages in the Early Copper Age. The geochemical signatures also suggest that different activities were carried out with less intensity at Okány-Futás (see Chapter 5, this volume).

Conclusions

Data collected during archaeological surveys by the Archaeological Topography of Hungary program and the Körös Regional Archaeological Project have been used to examine socioeconomic and cultural changes in the early agricultural societies that inhabited the Körös region of the Great Hungarian Plain. Diagnostic artifacts collected from sites identified during these surface surveys were compared to paleoenvironmental data to explore Late Neolithic and Early Copper Age settlement patterns at various geographic scales (Gyucha et al. 2011; see also Chapter 3, this volume). The regional and micro-regional studies indicate fundamental shifts from the nucleated settlement networks of the Late Neolithic, with actively maintained, long-term social boundaries, to a more dispersed pattern in the Early Copper Age, with sites that were organized into more fluid social units (Gyucha 2015; Gyucha et al. 2009, 2013; Parkinson 2006a).

Although the Late Neolithic aggregated sites were abandoned at the end of the period, the inhabitants did not leave the region. Instead, units of presumably kin-based, small-scale communities established their own villages across the landscape. The systematic surface collections in the Körös region confirmed that these sites were typically around 0.5 ha in extent, and the duration of their occupation might have been significantly shorter than that of their Neolithic counterparts (see Chapter 8, this volume).

Controlled surface collections conducted at the Early Copper Age sites of Körösladány-Bikeri, Vésztő-Bikeri, and Okány-Futás provided additional high-resolution data about site size and organization. When patterns from geophysical and soil chemistry studies were combined with the surface artifact distributions, it also was possible to gain a better understanding how these settlements were organized internally (see Chapters 5 and 6, this volume). Concentric activity zones were identified at the sites, with buildings in the central areas, and middens and animal penning areas in the outer zones. The results suggest that the number, size, and structure of buildings varied considerably from site to site (Gyucha et al. 2014; Parkinson et al. 2010b). The investigations also confirmed that some Early Copper Age villages were enclosed with ditches and palisades. More recent research by Gyucha (2015:106–7) demonstrated that in addition to small villages like the Bikeri sites and hamlets like Okány-Futás, there also were some larger settlements on the Great Hungarian Plain during the Early Copper Age, such as the one located near Geszt (Gyucha et al. 2014).

Chapter 5

Soil Chemistry

Meredith Hardy, Michael L. Galaty, Roderick B. Salisbury, and Doc M. Billingsley

Soil chemistry investigations of three Early Copper Age settlements within the Körös River basin were undertaken in concert with geophysical surveys between 2002 and 2007 (Lee et al. 2004; Parkinson et al. 2010a; Salisbury 2010, 2016; Sarris et al. 2004; Yerkes et al. 2007; see also Chapter 6, this volume). Two of the sites, Vésztő-Bikeri and Körösladány-Bikeri, are located on low rises overlooking a paleochannel northwest of the modern town of Vésztő, while the third, Okány-Futás, lies on a loess ridge located near the village of Okány, southeast of an old channel of the pre-regulation Sebes-Körös River (see Figure 1.2).

The Vésztő-Bikeri and Körösladány-Bikeri sites are 70 m apart and are separated by a modern drainage canal that was dug into the ancient meander of the Dió Creek (see Figure 1.3). Soil samples systematically collected from the Körösladány-Bikeri site were tested for total phosphorus (P_{tot}), percent of organic content, magnetic susceptibility, and pH. Field sampling strategies followed protocols established during the 2002 pilot geochemical and magnetic survey program at the Vésztő-Bikeri site. Additional surveys were conducted in 2003 at Körösladány-Bikeri and in 2006 and 2007 at Okány-Futás (Figures 5.1–5.2).

Nondestructive geochemical surveys, while not a substitute for careful excavations, provide spatial information to construct models of settlement organization that can be tested with targeted excavations (Salisbury 2012, 2013; Wilson et al. 2008). Geochemical surveys can detect subsurface features, such as middens, hearths, latrines, animal pens, food preparation areas, and other activity areas, and help delineate site boundaries. This is accomplished by measuring the physical properties of soils and by recording concentrations of chemicals, such as phosphorus, nitrogen, calcium, and carbon (Bethell and Máté 1989; Bjelajac et al. 1996; Eidt 1973; Holliday and Gartner 2007; Parnell et al. 2001; Roos and Nolan 2012; Salisbury 2012, 2013, 2016). However, phosphorus (or phosphate) analysis was emphasized in our investigations.

Phosphate Analysis

Higher phosphorus (P) levels in soils and sediments (when compared to natural levels) have been used as proxies for past human occupations and activities. Increased levels of phosphorus tend to be present around areas within settlement features, such as houses, animal enclosures, middens, burials, and places of food preparation, where organic materials were stored or left to decay. Different activities result in a variable horizontal distribution of phosphorus and other chemical elements across settlements. For example, phosphorus concentrations in animal pens or middens usually are higher than concentrations associated with food storage areas and hearths (Sjöberg 1976:452). Very low levels of phosphorus often are recorded at places

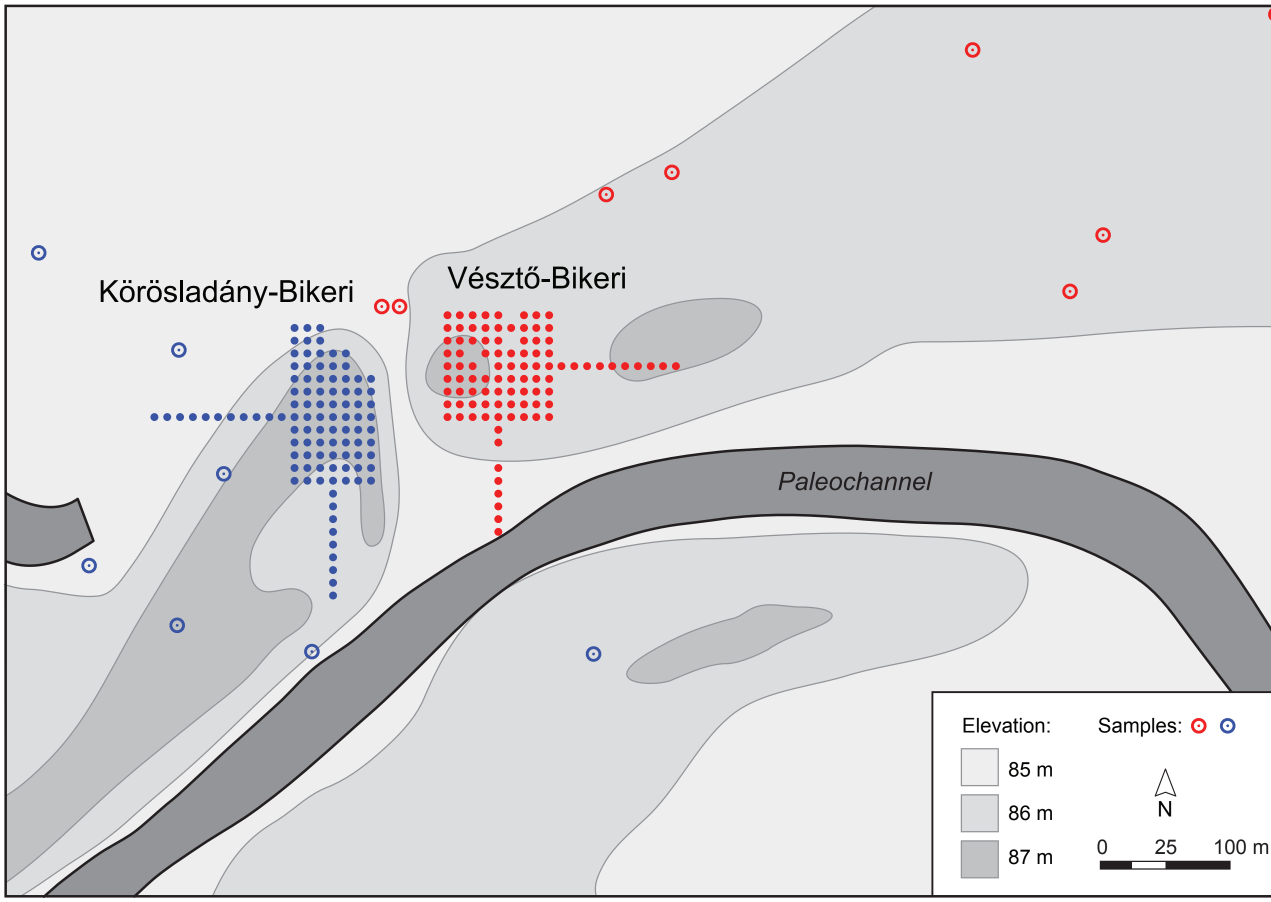


Figure 5.1. Sampling grids for geochemical surveys at Vésztő-Bikeri and Körösladány-Bikeri. *Figure by Jill Seagard.*

within settlements that were cleaned intentionally, such as plazas or courtyards.

Phosphate investigations originated with agronomic studies. In the late 1920s, the Swedish agronomist Olaf Arrhenius became the first person to relate phosphate studies to archaeology (Arrhenius 1923, 1963; Engelmark and Linderholm 1996; Herz and Garrison 1998; Terry et al. 2000). He concluded that concentrations of weak acid extractable phosphates could be used to indicate the presence of abandoned human settlements. Since Arrhenius's discovery, many archaeologists have used phosphate analysis to interpret and understand past human activities. The chemical traces of activities that occurred hundreds or thousands of years ago are often still evident, even if other material culture remains have been removed.

Phosphorus may be encountered in two forms: available or unavailable for plants. This availability may also be thought of as extractable (available: P_{av}) and total (unavailable: P_{tot}). Total phosphorus is found primarily in the subsoil (below the plowzone), is removed from the soil only by erosion, and serves as an indicator of past human activity. The soil's pH is a determining factor for P availability, as is sediment particle size. Alkaline soils form calcium carbonates that are easily absorbed by plants, while acidic soils form aluminum and iron phosphates that are slowly available for plant use (Sjöberg 1976:448). Phosphate fixation is high in clayey soils and low in coarse-grained soils.

Spot Tests

In the field, the technique most often used for phosphate analysis is the Grundlach test, a spot or ring test for the determination of P_{av} (Bjelajac et al. 1996; Eidt 1977; Holliday and Gartner 2007). In this method, samples are subjected to fast and relatively weak acid digestion, which causes a blue spot or ring through the reaction of phosphate with ammonium molybdate (or a molybdophosphoric compound). The shade of blue produced is proportional to the relative amount of P in the soil. With

Figure 5.2. Sampling grid for geochemical survey at Okány-Futás. *Figure by Jill Seagard.*

spot tests, a large number of samples can be processed at one time. These tests are relatively inexpensive and are easily conducted in field laboratories. Although this method is qualitative, Eidt (1973) and others have applied spot tests to gain a general understanding of the vertical and horizontal limits of occupation and identify general activity areas. Qualitative tests reveal levels of elements relative to each other and natural background levels. Modern and ancient human activities, such as agricultural fertilization, can increase the amount of P_{av}, but results from numerous studies indicate that the amount of extractable P is accumulative; in other words, archaeological anthrosols remain proportionately higher in P compared to background levels (e.g., Holliday and Gartner 2007; Salisbury 2012, 2016; Thurston 2001). These field tests are employed in the beginning stages of an archaeological project to identify site locations and boundaries both vertically and horizontally.

Total Phosphorus

On the other hand, P_{tot} produces quantitative results and is regarded as a reliable indicator of human activities that result in P deposition when compared to background, natural levels (Holliday and Gartner 2007). Perhaps the best techniques are those that combine P_{tot} with inorganic P to determine organic P, which is a percentage of P_{tot} (Engelmark and Linderholm 1996; Holliday and Gartner 2007).

Studies conducted at a fine scale can be used to investigate both intersite and intrasite relationships and activities (Engelmark and Linderholm 1996; Salisbury 2012, 2013; Sjöberg 1976:448; Thurston 2001). Intersite distributions of phosphates can identify dynamic relationships between structures, buildings, activity areas, burials, and middens, and comparisons between sites can enhance further understandings of regional settlement organizations and belief systems, among other things. Intrasite distributions of phosphates can be used to identify specific activity areas.

It has been demonstrated at sites located in such varied environments as northern Sweden, Denmark, Greece, Italy, Spain, Florida, Guatemala, Ecuador, and Puerto Rico that the chemical traces of activities that occurred hundreds or thousands of years ago are often still evident, even if the remnants of material culture have been removed. For example, at the Classic Maya Piedras Negras site in Guatemala, phosphate testing was used to detect specific human activity areas (Parnell et al. 2001; Terry et al. 2000). Gardens were differentiated from suburbs, middens, and agricultural production areas. Several tests were used, and their validity and efficiency were compared. Thurston (2001) used phosphate analysis in a multiscalar investigation of pre-state integration and acculturation into an invasive state society. Changes in land use and settlement organization from pre-Christian to Christian periods were identified through soil chemical analysis, artifact distribution, and historic documentation (Thurston 2001:17). This study not only reconstructed settlement patterns but also showed how the structure of Iron Age settlements varied in relation to sociopolitical organization. The method has also been used at a smaller scale to identify an eighteenth-century French fort in Illinois (Woods 1984).

Soils in the Study Area

The Great Hungarian Plain is a sedimentary basin filled with Quaternary fluvial deposits overlain by aeolian loess and sand in some places (Kosse 1979; Pécsi 1970; Pécsi and Sárfalvi 1964; Várallyay 1993; see also Chapter 2, this volume). In the past 720,000 years, more than 150 m of clay, silt, and fine sand have been deposited in the Körös Regional Archaeological Project study area (Gyucha et al. 2011; Rónai 1997). Most of these deposits were laid down during glacial phases, when aeolian and alluvial sediment inputs increased. Sedimentation during the Holocene appears to have been minimal. There are numerous meandering rivers and streams throughout the basin that erode the silts and loess, creating meanders and oxbow lakes (see Chapters 2 and 3, this volume).

During the Late Neolithic period and the Early Copper Age, shifting river channels and flooding do not seem to have forced human societies to alter their settlement and subsistence patterns. By clearing forests, cultivating crops, grazing animals, constructing ditches, and “mounding over” abandoned structures and settlements, human agents modified the landscape in and around their villages to a greater degree than did natural forces (Gardner 2002; Magyari et al. 2012; Willis 2007).

A variety of soil types are found in the Körös region. Chernozems (well-drained prairie or steppe soils with thick A horizons) and several suborders of mollisols (dark grassland soils rich in organic matter) that formed from flood silts are found on the loess-covered alluvial fans in the western end of the study area (Várallyay 1993), while alfisols in the Körös River basin probably formed under forests. Alfisols have argillic (clay) horizons and develop on fairly stable land surfaces where silicate clays can be eluviated (Foth and Schafer 1980:143). Most of the lower-elevation areas of the Körös Basin are mantled by pedogenically problematic meadow clay soils (*réti talajok*) that are characterized by 40 to 100 cm–thick, dark brown to black, dense, generally featureless silty clay A horizons above strongly mottled and weakly developed silty clay loam subsoils (Gyucha et al. 2011; Várallyay 1993:38–40; see also Chapter 2, this volume). Meadow clays are similar to some soils found on mid-latitude grasslands that are subject to pronounced seasonal droughts, and they seem largely to have been avoided by both Neolithic and Copper Age groups (Ecsedy et al. 1982; Gyucha and Duffy 2008; Gyucha et al. 2011; Kosse 1979; Parkinson 2006a; Sherratt 1983a). The parent material for the meadow clays was aeolian and redeposited aeolian sediments, or loess; however, vertic mixing of these smectite-rich soils has blurred any stratigraphic clues. Hence the age and relative contributions of alluvial and colluvial sediment in their formation remain in question (Gyucha et al. 2011; Várallyay 1993). Mollisols develop in flat, undulating plains with continental climates that are subject to cold winters and hot summers, and typically have surface (O–A) horizons greater than 25 cm thick. Some can be up to 1 m in thickness (Foth and Schafer 1980:111). These A horizons are brown or black (chernozems), and humus develops as a result of deeply rooted grasses that die back annually and enrich the soil. In drier areas, such as on steppes, the A_1 horizons are shallower, B_w horizons are less likely to develop, calcareous horizons may develop, with their depths dependent on rainfall, and calcium carbonates often accumulate between upper A and C horizons.

Salt-affected agricultural steppe solonetz soils (*sztyeppesedő réti szolonyecek*) are found in zones between black, humus-rich alluvial silts and meadow clays, resulting from higher groundwater and the upward movement of salts during the hot, dry summers. They often are found on lightly elevated “islands” that dot the Körös River floodplains. A horizons of solonetz soils are typically thick, and carbonates are often present in the lower A. The climate of the region has been characterized as semiarid

"Mediterranean" or semiarid to semi-humid, marked by seasonal droughts and wet periods—conditions that would favor the development of these types of soils (Borhidi 1993; Kosse 1979; Pécsi and Sárfalvi 1964).

Field Methods

At Vésztő-Bikeri, soil samples were collected in 10 m intervals within a 9,400 m^2 grid (Figure 5.1). Additionally, two transects were extended 100 m beyond the site limits, one to the east and one to the south, and samples were also taken from nine control points to establish the natural background levels (Sarris et al. 2004). The soil cores were taken using an Oakfield hand coring device, and samples were extracted from both the Ap (15 to 20 cm below surface, or cmbs) and sub-plow horizons (45 to 50 cmbs). Both sets of samples were tested for extractable phosphorus to assess the effect of modern activities on archaeological chemical signatures. The samples were tested with a colorimetric technique for molybdate reactive phosphorus (MRP), which reduces the sample to a molybdenum blue that is proportional to phosphate concentrations (Lee et al. 2004; Sarris et al. 2004).

A similar sampling strategy was employed in 2003 at Körösladány-Bikeri. Samples were taken in 10 m intervals on a grid covering 4,800 m^2, with transects extending off-site 100 m to the west and south for background samples (Figure 5.1). Finally, six cores were taken from randomly selected points to provide off-site levels. Samples were extracted from both the plowzone (Ap, 15 to 20 cmbs) and sub-plow horizons (45 to 50 cmbs), and the sub-plowzone samples were analyzed for total phosphorus, percent of organic content, magnetic susceptibility, and pH (Hardy 2005; Lee et al. 2004; Sarris et al. 2004). Thirty-one of the 84 samples were from off-site areas. All sample points were mapped with a total station and entered into a GIS database (using ArcGIS 8.1).

For the Okány-Futás site, 154 samples were collected from 59 cores in 2006, and another 279 samples were extracted from 98 cores in 2007 for a total of 433 samples from 157 cores (Figure 5.2). The data presented in this chapter are the combined results of tests for P on the 2006 and 2007 samples. A more extensive geochemical analysis of the samples from Okány-Futás was conducted by Salisbury (2016) as part of his dissertation. Although he examined levels of 19 other chemicals in the samples, only the phosphate results are reported here for comparison with P results from Vésztő-Bikeri and Körösladány-Bikeri. All samples were taken with an Oakfield soil corer at 10 m intervals along a grid covering an area of 13,000 m^2, with 50 m transects extending beyond the established site limits in each of the cardinal directions. Six additional off-site control samples were taken to establish culturally sterile geochemical signatures: two heading north along a loess ridge, three to the east, and one to the south. All off-site samples were collected outside site boundaries but within the same field, with the exception of one background sample to the south. Samples were taken from the base of the plowzone or top of the cultural layer (approximately 30 to 40 cmbs) and again from the top of the subsoil (typically 45 to 55 cmbs). Samples were air-dried, ground, and stored in reclosable poly bags. Sample points were mapped with a GPS unit and contour maps were generated in ArcGIS 9.1 and QGIS 2.16, based on assigned P values.

Laboratory Tests and Results

Both plowzone and sub-plowzone samples from Vésztő-Bikeri and Körösladány-Bikeri were tested for extractable phosphorus to assess the effect of modern activities on archaeological chemical signatures. The samples from both sites were tested with a colorimetric technique for MRP, based on a modification of the methods outlined by Murphy and Riley (1962). Additional analyses were conducted on 84 of the 105 sub-plowzone soil samples from Körösladány-Bikeri for total phosphorus, extractable phosphorus, percent of organic content, and pH (Hardy 2005). All tests were in accordance with procedures for the processing and testing of sediments as established by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers (Plumb 1981). Total phosphorus (TP) was measured in micrograms per kilogram in dry weight (μb P/kg). Organic loss was conducted as a loss of ignition (LOI%), in which samples were dried and combusted. The pH was determined for selected samples associated with different types of magnetic anomalies. Total phosphate for dry weight was calculated as follows:

$$\text{Total phosphate mg/kg (dry weight)} = \frac{(x)\,(y)\,(1000)}{(g)\,(\%S)}$$

where x = phosphate concentration in sediment digest, mg/l; y = final volume of sediment digest, l; g = wet weight of sample digest, g; %S = percent solids in sediment sample as a decimal fraction. It was found that these samples could not maintain neutrality because carbonates were present, so all samples were run three times to establish confidence, and the results were averaged.

For the Okány-Futás samples, the laboratory process involved the ring chromatography test, or spot test (Eidt 1973; Gundlach 1961), using two mixed reagents and a stop-bath. The first reagent consisted of 35 ml 6N hydrochloric acid and 5.0 g ammonium molybdate diluted with 100 ml distilled water in a Nalgene bottle with a single-drop dispenser nozzle, while the second consisted of 0.5 g ascorbic acid mixed with 100 ml distilled water in a similar dispenser. The stop-bath consisted of 64.7 g natrium citrate, 9.24 g sodium bicarbonate, and 1.0 l distilled water. Twenty samples of 0.2 g dried and pulverized soil were placed on a sheet of Whatman #4 qualitative filter paper. Two drops of the first reagent were placed onto each sample, and 30 seconds later two drops of the second reagent were applied. After developing for 150 seconds, the filter paper was dipped in the stop-bath and the results were recorded on a relative scale ranging from 1 to 5, with 5 being the darkest concentration of blue coloring, representing the highest value of elevated P_{av}.

Vésztő-Bikeri

The 74 deep, on-site samples analyzed by colorimeter from Vésztő-Bikeri ranged in level of light transmission from a low of 1 percent (i.e., very high phosphorus content) to a high of 81.5 percent, with an average of 26 percent. By contrast, the 50 deep, off-site samples ranged from a low of 1.5 percent to a high of 78 percent, with an average of 40 percent. Very low values obtained along the east–west transect, which skew the off-site average downward, were associated with modern agricultural activity. The on-site samples linked to features identified by geophysical prospection ranged from a low of 2 percent to a high of 22.5 percent, with an average of 9.6 percent. In general, samples from the plowzone were lower in phosphorus than those from the deeper cultural layers. The results from Vésztő-Bikeri thereby reinforce the impression, further supported at Körösladány-Bikeri and Okány-Futás, that archaeological sites on the Great Hungarian Plain are easily identified by high phosphate levels relative to surrounding, natural background levels.

Körösladány-Bikeri

The 31 off-site samples from Körösladány-Bikeri ranged in concentration from 147 µm/kg dry weight to 3 µm/kg; the average for off-site samples was 59.5 µm/kg. All but six of these samples were below 90 µm/kg, 15 were at or below 50 µm/kg, and only six were below 20 µm/kg. Average P_{tot} across the on-site area was 86 µm/kg, ranging from a high of 283 µm/kg to a low of 4 µm/kg. Twenty-seven of the on-site samples were below 90 µm/kg, and 12 were above 100 µm/kg. The highest P_{tot} values, ranging between 189 and 283 µm/kg, tended to be concentrated toward the northern half of the site, while elevated levels, ranging from 165 µm/kg to 104 µm/kg, were distributed across the site. P_{tot} values lower than those for off-site areas, ranging from 25 µm/kg to 11 µm/kg, were located near the site's interior; however, a second area of even lower values, ranging between 10 and 4 µm/kg, was located near the site's southern perimeter.

Extractable phosphorus (P_{av}) results ranged between 0 and 23.5299 µm/kg. Higher extractable results that appeared to correlate with higher P_{tot} results were found in sample numbers 5, 35, 37, 40, and 58 (EP: 12.8327, 23.5299, 19.8095, 12.7635, and 12.8560 µm/kg, respectively; P_{tot}: 254.837, 153.752, 198.339, 152.214, and 170.203 µm/kg, respectively). However, two samples, numbers 82 and 83 (13.5910 and 13.5677 µm/kg, respectively), were associated with mid- to low-range P_{tot} results (39.988 and 92.875 µm/kg, respectively).

The representative samples tested for pH ranged from 5.87 to 9.7 across the Körösladány-Bikeri site. The majority of samples (n = 7) were weak to moderately base and fell between pH 7.1 and 7.9, followed by five samples that ranged from pH 6.1 to 6.9. Three samples fell between pH 8.1 and 8.9, and three between pH 9.1 and 9.9. The three samples with the highest pH (numbers 44, 45, and 46) were correlated to low P_{tot} and P_{av} values, while those in the middle ranges (pH 7–8) tended to correlate with medium to mid-high values for P_{tot} (75–125 and 126–195) and P_{av} (6–10 and 11–15).

Okány-Futás

At Okány-Futás, on-site samples from the upper layers (total n = 149, averaging 29 cmbs and ranging from 20 to 35 cmbs) had on average moderate levels of P_{av} (assigned to spot test Category 3, n = 38). Categories 2 and 4 (n = 32) were the next most represented, followed by Category 5 (n = 26), with the fewest samples in Category 1 (n = 21).

In contrast, the majority of subsoil samples (total n = 149, averaging 47 cmbs and ranging from 30 to 100 cmbs) were categorized as 5 (high, n = 51, average depth of 49 cmbs). This was followed by Category 4 (n = 43, average depth of 47 cmbs), Categories 2 and 3 (both n = 25, average depth of 47 cmbs), and Category 1 (n = 5, average depth of 39 cmbs). In all but 59 cores, the upper layers contained less P than the subsoil; in these 59 cases, there was no difference in the relative presence of P between upper and lower zones. The lowest values are also the shallowest, and the highest values are the deepest on average. However, it should be noted that the highest values include several samples from beneath deep features, presumably pits, all of which had high P values. The combined evidence from the subsoil samples suggests that some phosphates have leached from cultural deposits into the subsoil.

Of 16 samples (from eight cores) taken to provide background P_{av} values, 13 samples were low to moderately low. The major exceptions were in core numbers 78 (40 m north of the assumed site boundary) and 130 (50 m south of the assumed boundary). In both of these cores, values from the upper layer were moderate (Category 3) and those from the subsoil samples were high (Category 5).

Eight samples from Okány-Futás—six from on-site and two from off-site—were tested for pH. The mean pH of all samples was 5.19, with on-site samples averaging 5.25 and off-site samples averaging 5.0. These results indicate that soils at Okány-Futás can be characterized as more acidic than the Bikeri sites, most likely due to underlying geology/parent soils and different topographic conditions.

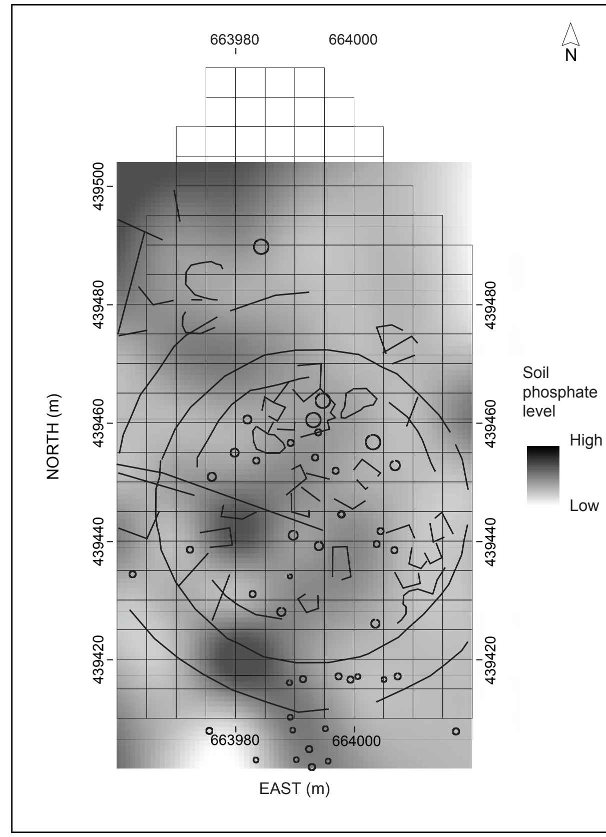


Figure 5.4. Results of soil phosphate analysis and magnetic anomalies at Körösladány-Bikeri. *Figure by Roderick B. Salisbury, Margaret Morris Downing, and Jill Seagard.*

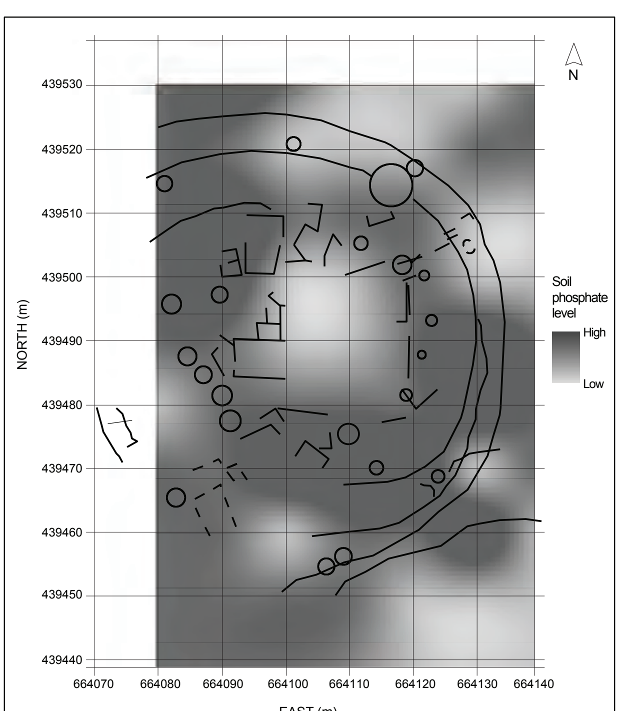


Figure 5.3. Results of soil phosphate analysis and magnetic anomalies at Vésztő-Bikeri. *Figure by Roderick B. Salisbury, Margaret Morris Downing, and Jill Seagard.*

Interpretations

Vésztő-Bikeri

The soil chemical surveys recorded high concentrations of phosphate around the perimeter of the Vésztő-Bikeri site, near the circular enclosure (Figure 5.3). Lower levels were measured in the central area of the site. This pattern fits the model for agricultural settlements where residents removed organic waste from living quarters and deposited their trash in "ring middens" at the perimeter of the sites. The low phosphorus levels in the area near the structures also seem to indicate that organic waste was not a constituent of the daub in building walls at Vésztő-Bikeri. On the other hand, higher levels of phosphorus were recorded in the area where possible kilns, ovens, pits, or hearths were mapped during the magnetic survey (see Chapter 6, this volume), probably associated with the residues of organic material used in cooking, food storage, and ceramic production.

Körösladány-Bikeri

A different pattern was found in the soil samples from Körösladány-Bikeri. The highest P_{tot} values were concentrated in the northern half of the site, but elevated levels were distributed across the site (Figure 5.4). P_{tot} values lower than those for off-site areas were located near the site's interior; however, a second area of even lower values was located near the site's southern perimeter. Higher extractable phosphorus values seemed to correlate with the higher P_{tot} results (Hardy 2005). The representative samples tested for pH across the site varied from 5.87 to 9.7.

Site Boundaries: Vésztő-Bikeri and Körösladány-Bikeri

Contour maps generated for both Vésztő-Bikeri and Körösladány-Bikeri were based on the soil chemistry and magnetic survey results. These maps helped represent the boundaries of both sites (Figures 5.3–5.4). The highest values of P_{av} were typically located in close proximity to each site's perimeter, while high values were also recorded in areas that were identified by the magnetic survey and tentatively interpreted as kilns, ovens, pits, or hearths. At Körösladány-Bikeri, soil phosphate values were highest near the circular magnetic anomalies, while lower values were associated with the rectilinear features (see Chapter 6, this volume). Breaks in the high-value phosphate contours around the perimeters of the two sites may represent entryways (Parkinson et al. 2004a, 2010b; Sarris et al. 2004; Yerkes et al. 2007).

Overall, the distribution patterns of P from our studies are consistent with models for agricultural settlements where residents discard their refuse in middens that ring the settlement perimeter, while more central, common areas are intentionally cleaned of refuse. The high phosphorus values not associated with the perimeter itself, either toward the center or outside of the site's perimeter, may be indicative of animal storage and penning.

Okány-Futás

The pattern observed at Okány-Futás indicates a southwest–northeast band of high phosphate levels, suggesting that the occupation zone roughly follows the loess ridge. Magnetic survey results and the presence of burned daub clustering in the surface collections were used to identify structures at Okány-Futás (Figure 5.5; Parkinson et al. 2010b; Sarris 2006; see also Chapters 4 and 6, this volume). The areas with the highest P levels at Okány-Futás are not located at the perimeter of the site. Rather, the highest levels appear to be around the structures, contrasting with the circular patterns at both Körösladány-Bikeri and Vésztő-Bikeri (Parkinson et al. 2010b; Sarris et al. 2004; Yerkes et al. 2007). Phosphate levels appear to occur just outside the structures and trend toward the southeast, away from the paleochannel. The highest phosphate levels occur approximately 30 m to the east, in association with a surface concentration of burned daub. The pattern observed could relate to an occupation of shorter duration by a smaller population compared to the occupation of the Bikeri sites. The structures at Okány-Futás may have been burned and then mounded over with refuse after they were abandoned. Alternatively, this pattern could be representative of an unenclosed settlement wherein the boundaries of daily activities were not constricted by a palisade.

Along the southern transect, phosphorus values remained moderately elevated for 50 m beyond the agricultural fields, through the neighboring tree line, and into

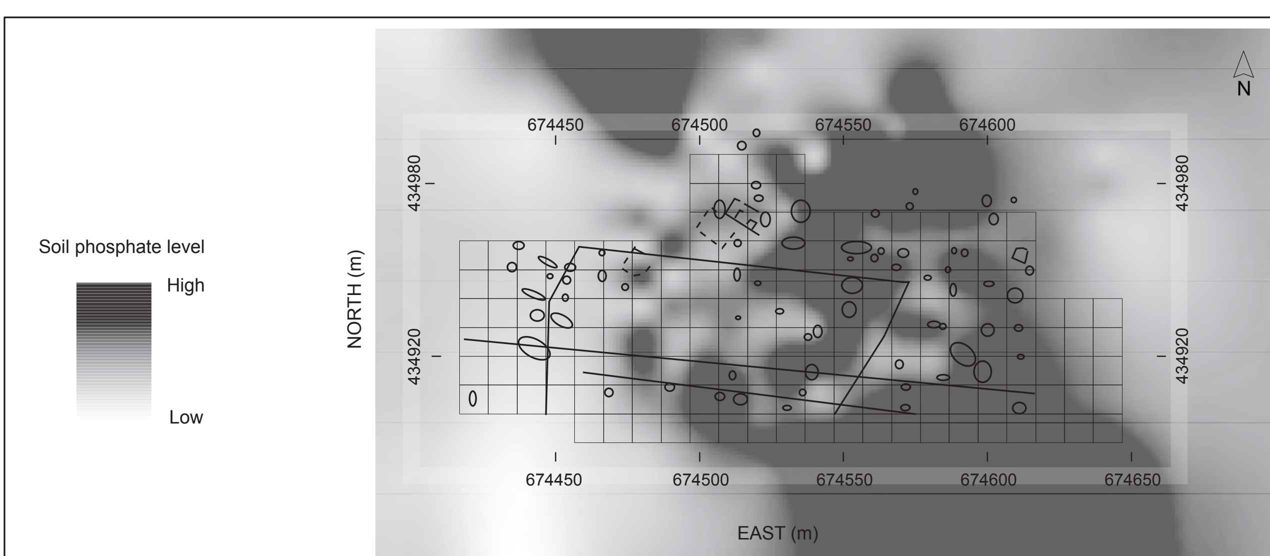


Figure 5.5. Results of soil phosphate analysis and magnetic anomalies at Okány-Futás. *Figure by Roderick B. Salisbury, Margaret Morris Downing, and Jill Seagard.*

the next field to the south. This series of moderately high readings suggests that part of the occupation may have extended into the wooded area that now forms a boundary between the modern field systems. This may indicate that the site expanded beyond the distribution of ceramics collected on the surface. The wooded area is covered with vegetation year-round, making archaeological surface survey difficult. To the north and east, phosphorus values quickly dropped to within the natural background values, marking a distinctive boundary. It also appeared that modern agricultural practices have not greatly altered the relationship between on-site and background levels of phosphorus, and there was no evidence for skewing of the results by differential fertilization.

Conclusions

Until the last decade, geochemical studies of archaeological sites were largely written off by many archaeologists as unproductive because they produced seemingly ambiguous results. However, with the quantifiable techniques that exist today, geochemical studies are viable and testable. Results from soil chemistry surveys can reveal some of the direct impacts that people have had on their surroundings. These kinds of studies can contribute to our understanding of site function and layout (Salisbury 2012, 2013). The in-field methods used for quick determination of the presence or absence of phosphorus in soils are also useful tools for identifying human occupation and archaeological site boundaries. However, these kinds of spot tests are limited because they are indicative only of relative amounts of phosphorus present.

In accordance with the results of geophysical and surface surveys (see Chapters 4 and 6, this volume), the geochemical investigations show that the sizes of the two Early Copper Age villages at Vésztő-Bikeri and Körösladány-Bikeri are much smaller than the nucleated Late Neolithic settlements on the Great Hungarian Plain (see Gyucha et al. 2015; Kalicz and Raczky 1987a; Raczky 1995b). The studies confirm that the Bikeri villages were similarly organized, with central areas that were kept clean and with zones of middens and animal pens toward and near the perimeters; the resulting patterns indicate village boundaries that coincide with the circular enclosures surrounding the sites. The results of the geochemical survey at Okány-Futás show that the layout and organization of Early Copper Age hamlets did not conform to this enclosed village pattern. Instead, the small settlement at Okány-Futás appears to have spread from southwest to northeast along a loess ridge. Additional testing at other sites across the region will further enhance our understanding of past life and activities across the Körös region.

Chapter 6

Geophysical Remote Sensing

Apostolos Sarris

Geophysical methods are used for detecting various types of subsurface soil features, such as pits, wall foundations, ditches, middens, hearths, kilns, and concentrations of pottery or building rubble. These methods are nondestructive and involve measuring the physical properties of soils (such as magnetic susceptibility, electrical resistance, or propagation velocity of electromagnetic waves) on or below the surface of a site. Magnetic or soil resistance methods are most effective for mapping extensive areas containing architectural remains and residues of past anthropogenic activity. A number of successful and informative geophysical surveys have been conducted at Neolithic and Bronze Age settlements in Europe (e.g., Becker 1996; Doneus et al. 2001; Eder-Hinderleitner et al. 1996; Kuzma and Tirpák 2001; Sarris et al. 2001; Sharpe 2001).

Magnetic Susceptibility Measurements

Local fluctuations of the geomagnetic field are caused by contrasts in rock magnetization or by soils that are rich in magnetic oxides. The magnetization of rocks includes inductive and remnant magnetization. Inductive magnetization originates in Earth's magnetic field and depends on the actual strength of the field, its orientation, and the magnetic susceptibility (χ) of rocks or soils. In contrast, remnant magnetization is constant and remains unaffected by alterations to the local magnetic field (Sarris 2008). Subsurface targets with magnetic properties different from those of the surrounding soil matrix change the local magnetic field and create the readings that are recorded in magnetic surveys. These anomalous magnetic readings are directly related to the magnetic susceptibility of the soil or cultural feature. Areas with enhanced magnetic susceptibility (with respect to the surrounding soil matrix) are measured as positive anomalies, while areas with lower concentrations of ferrous oxides (and reduced magnetic susceptibility) are represented as negative magnetic anomalies. Features, such as pits, wall trenches, burned soils, structures, and ditches, have a different (usually increased) magnetic susceptibility than the surrounding soil matrix and thus create a weak magnetic field that alters the local magnetic field (Aitken 1974; Weymouth 1986).

The magnetic contrast between subsurface targets and their surrounding soils plays a critical role for the success of a magnetic survey. Measurements of the magnetic susceptibility can reflect the ability of materials to undergo magnetization (usually reflecting the content of magnetic minerals in a sample) and thus their potential of being recorded in a magnetic survey. Mullins and Tite (1973:804) have also shown that a significant variation in susceptibility with frequency is observed in small-size single-domain (SD) grains, in contrast to large-size multi-domain (MD) grains (no quadrature susceptibility, no frequency variation of susceptibility, and very small magnetic viscosity). As the frequency of the external AC field is increased, susceptibility is expected to decrease, since the magnetic viscosity slows down the reaction of the magnetic grains to the changing direction of the AC field. Soil grains around the single-domain/super-paramagnetic domain boundary display a magnetic viscosity resistance to high frequency measurements, and thus their apparent susceptibility falls off sharply with increasing frequency (that is, there is a high frequency dependence inversely proportional to the susceptibility). Magnetic susceptibility can provide information regarding the extent, dating, duration, and intensity of human occupation, since human activity, weathering, and burning can enhance the conversion of large-size magnetic particles to a smaller size characterized by high frequency dependent susceptibility (FDS). Thus, dual frequency measurements of magnetic susceptibility are able to distinguish the multi-domain grains most likely derived from parent material or natural processes from the single-domain (larger frequency dependent) grains of soils affected by human activity (Clark 1988, 1990:99–117; Eyre 1997; Sarris 2008; Worm 1998). With respect to the practical issues of a magnetic survey, it also can offer feedback about the potential of a site to produce strong and significant signals through the comparison of the contrast between features and their soil matrix with the average levels of the topsoil magnetic susceptibility (Clark 1990:103–4; Oldfield et al. 1983:37–44; Sarris 1992).

In 2004, 180 samples were collected at 10 m intervals from the Vésztő-Bikeri and Körösladány-Bikeri sites, and measurements of the soil mass magnetic susceptibility were taken at the Institute for Mediterranean Studies at the Foundation for Research and Technology–Hellas (FORTH) in Crete, with the assistance of Luigi Catanoso, under the auspices of the Leonardo Da Vinci Training Program (Sarris and Catanoso 2005). The susceptibility magnetic measurements were taken in units of 1 x 10^{-6} cgs/g using a dual frequency (f_{low} = 0.43 KHz and f_{high} = 4.3 KHz) sensor MS2B (Bartington Instruments 1988). Similar samples from a total area of 9,400 m² at Vésztő-Bikeri and 4,800 m² at Körösladány-Bikeri were subjected to chemical analysis (for example, phosphate concentration, organic content, pH) to provide information complementary to the magnetic susceptibility measurements (for example, identifying areas of animal pens, middens, and food storage areas; see Chapter 5, this volume).

Magnetometers and Gradiometers

Proton or caesium magnetometers are used to measure total magnetic field strength, while proton, caesium, or fluxgate gradiometers are used to measure the vertical or horizontal gradient of the total magnetic field or one of its components. During the course of the Körös Regional Archaeological Project, a Geoscan FM36/256 fluxgate gradiometer and a Bartington G601 fluxgate gradiometer were used to measure the vertical gradient of the local magnetic field, namely the difference between the vertical component of the magnetic field at two different heights. The two gradiometer sensors (spaced 0.5 m and 1.0 m apart, correspondingly) are very sensitive to anomalies up to 1.5 m (for the FM36/256) and 2.5–3 m (for the G601) below the surface. The instruments are able to read the vertical gradient of the magnetic field with an accuracy of 0.1 nT/m. The magnetic surveys were conducted by walking from south to north along 0.5 m spaced transects and taking measurements every 0.5 m or 0.25 m (Figure 6.1). Although the readings of the fluxgate gradiometer do not need any corrections for the diurnal variation of the magnetic field, the instruments required frequent readjustment to avoid drifting effects due to high temperatures.

At each site, a number of rectangular grids of different dimensions (20 x 20 m or smaller) were laid out to achieve the maximum coverage of the Early Copper Age sites and the multicomponent Vésztő-Mágor tell (Sarris 2003, 2004, 2006). Even though there was a frequent readjustment of the instruments (at the start of every grid), magnetic measurements were characterized by a constant shift of the average value within each survey grid caused by the shifting of base/reference stations and the gradual unbalancing of the instruments. Thus all values of the individual grids were reduced to a common base level (0-level). Kriging interpolation using a linear variogram was employed for gridding the raw data, and the process was repeated after the application of selective de-spiking techniques that were used to isolate the extreme values that masked the anomalies of interest.

Compression of the dynamic range and high-pass filters were applied to isolate anomalies close to the background level, and masking filters were employed to isolate the areas that were not surveyed due to the presence of surface features, modern structures, or excavation trenches. Equalization of the values along both x- and y-axes also smoothed the data and pinpointed the weaker signals. Most of the above processes were carried out through the use of Surfer and the GPP package (Kalokerinos et al. 2004). Interpretation maps were made based on the features that were identified along all the processing stages. Color and grayscale maps were produced; hot (reddish) colors in color maps and light (white) colors in grayscale maps represented high-intensity values, whereas cold (bluish) colors in color maps and dark (black) colors in

Figure 6.1. Magnetic survey by Apostolos Sarris using the Bartington G601 fluxgate gradiometer (A). Magnetic survey by Nikos Papadopoulos using the Geoscan FM36/256 fluxgate gradiometer (B). *Figure by William A. Parkinson.*

grayscale maps represented low-intensity features. In the end, all magnetic maps were rectified in ArcGIS, and the corresponding anomalies were digitized and placed in different shapefiles. The rest of the topographic data related to the results of the excavations or aerial imagery of the region also were overlaid to contribute to the better interpretation of the geophysical anomalies and the future planning of excavations.

Vésztő-Bikeri

The Early Copper Age settlement at Vésztő-Bikeri is located on a low ridge overlooking the Dió Creek, which is currently a modern drainage canal that was dug into a paleochannel of the Körös River system (see Figure 1.2). During surface collections, in addition to bones and large amounts of daub, exclusively Early Copper Age ceramics were found at the site (Ecsedy et al. 1982; Parkinson 2006a; see also Chapter 4, this volume). The first phase of the geophysical investigations of the Körös Regional Archaeological Project was conducted at this site. Previous excavations by the project in 2000 and 2001 had confirmed that the Early Copper Age stratigraphy at the site was less disturbed by plowing than at many other Tiszapolgár settlements characterized by shallow cultural layers (Bognár-Kutzián 1963, 1972; Ecsedy et al. 1982; Jankovich et al. 1989, 1998; Parkinson 2002; see also Chapters 7 and 8, this volume). The surface material at Vésztő-Bikeri indicated a high degree of spatial integrity (Parkinson et al. 2002). The initial excavations exposed burned wattle-and-daub structures, wall trenches, and a few pits. Thus, to provide a better understanding of the spatial distribution of architectural features and activity areas in the settlement, a geophysical survey, including magnetometry over an area of 5,000 m², and a geochemical campaign were carried out in the summer of 2002 (Sarris 2003; see also Chapter 5, this volume).

Results of Geophysical Surveys at Vésztő-Bikeri

The mosaic of the geophysical grids measured at 0.5 m intervals showed a systematic drift of the magnetic values (Figures 6.2–6.3), which was especially evident in the western and southern edges of the Early Copper Age village. Some subtle anomalies were present in the central area as well. When the data were rectified to the 0-level baseline, the concentric curvilinear features at the site margin and the rectangular wall trench structures in the central area were more clearly delineated. When a better resolution was obtained by resurveying sections of the site at a 0.25 m interval, the boundaries of these features became sharper and other anomalies became clearer. There are no visible traces of the large, circular enclosures and the rectangular wall trench features on the surface at the Vésztő-Bikeri site.

The geophysical signature of the circular enclosures indicated that they were concentric ditches; the diameter of the narrow inner ditch is approximately 65 m, and the wider outer ditch is about 75 m across (Figure 6.2). The nonuniform magnetic signature of these circular anomalies suggested that there were postholes in the trenches. The narrow inner ditch was better defined. While the ditches appear to have encircled the settlement, their magnetic signal is weaker in the west and southwest because these parts may have been eroded through cultivation and/or periodic flooding near the Dió Creek paleochannel that separates Vésztő-Bikeri and Köröstladány-Bikeri (Figure 6.3).

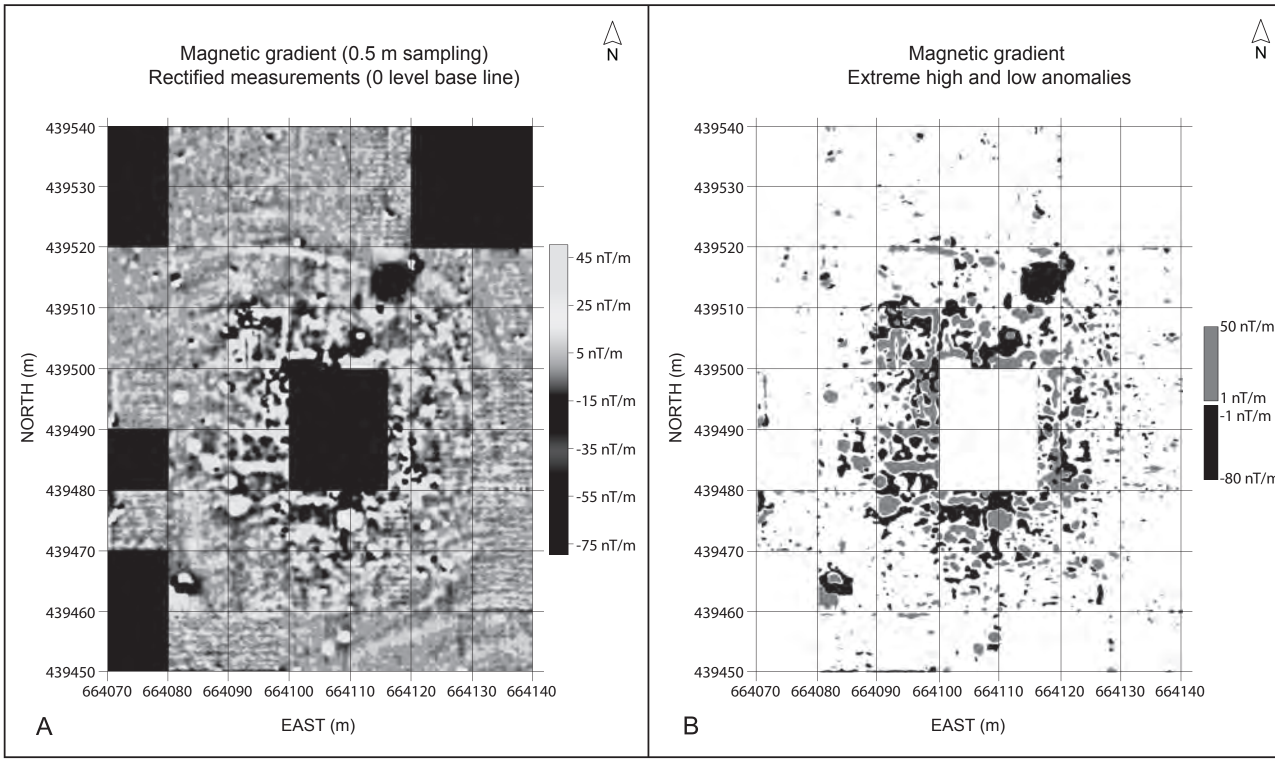


Figure 6.2. Results of high-resolution magnetic surveys at Vésztő-Bikeri. A: Magnetic gradient generated by rectified measurements at 0.5 m sampling; B: More intensive anomalies revealed by extreme (low and high) values of the vertical magnetic gradient. *Figure by Apostolos Sarris and Jill Seagard.*

The circular ditches exhibit a slightly higher magnetic signal with respect to background values, but somewhat lower compared to the signals registered by other architectural features of the site (anomalies A1–A11). The signal for the ditches is due to the increased magnetic susceptibility (through the reduction/oxidation cycles) resulting from the concentration of organic material in the ditch fills. A couple of discontinuities (close to anomalies C3 and B12) also are present along the perimeter of the ditches and may represent entrances to the village (Figure 6.3).

Two long excavation trenches (Blocks 5 and 6) of 1 x 15 m and 1 x 10 m were laid out in 2002 to bisect the ditches. Excavations confirmed both the inner and outer ditches (see Chapters 7 and 8, this volume). The middle ditch was not detected by the magnetic survey (Figures 6.2–6.3). Both the inner and outer ditches contained Early Copper Age Tiszapolgár ceramics, burned daub, bone, charcoal, and shell, but very few artifacts were found in the middle ditch.

The enhanced magnetic signals associated with the 11 recognizable structures at the site (A1–A11) are due to the presence of burned daub and artifacts in the wall trench fills as well as the depth and width of these linear features. Low-magnetic, isolated anomalies within the structures could be related to postholes. Some of these architectural features are clearly defined around the central excavated area, especially in the northwest and west sections. The most significant architectural remains can be identified with anomalies A1, A3, A4, and A5. A 2 x 2 m test excavation unit (Block 1) exposed a part of the wall trench associated with anomaly A1, the magnetic signature of which showed that it is about 10 m long (north–south) and 5 m wide (east–west). A smaller feature (A2) measuring 4 x 3 m extends to the southwest corner of anomaly A1. A north–south alignment also is evident for anomalies A3 and A4, with dimensions of 5 x 8 m and 3 x 3 m, respectively. Anomalies A3, A4, and A10 are correlated with other architectural features that partially fell within the central excavation area. An 8 x 12 m excavation unit (Block 9) confirmed that anomaly A3 includes linear features that represent the northern, western, and southern foundation trenches of the Feature 15 longhouse, the eastern part of which was exposed in Block 2 (Figure 6.3; Gyucha et al. 2006; Parkinson et al. 2010b; see also Chapters 7 and 8, this volume). The other architectural anomalies (A5, A6, A7, A8, A10, and A11) form a tight arc around the center of the Vésztő-Bikeri site. Finally, anomalies A12 and A13, although not as distinctive as the previously mentioned ones, were correlated with the location where human remains were found on the surface (Parkinson 2002, 2006a; see also Chapter 4, this volume).

Some of the north–south aligned dipole anomalies (such as B1, B3, and B5) are related to metal objects, whereas a few of them (such as B15) are so intensive (reaching values higher than 250 nT/m) that they mask large surrounding areas. In contrast, the lower values of the vertical magnetic gradient (up to 30 nT/m) in the area of anomaly B14 suggested the existence of a kiln, oven, or large hearth. Excavations and coring at this location (Block 8) in summer 2003 revealed a 3 m-deep well or cistern (with a diameter of 1.8 m) filled in with large burned daub fragments. Rectangular ovens or kilns were constructed inside the feature on top of the daub fill just below the surface (Parkinson et al. 2004a, 2004b, 2010b; Yerkes et al. 2007; see also Chapters 7 and 8, this volume).

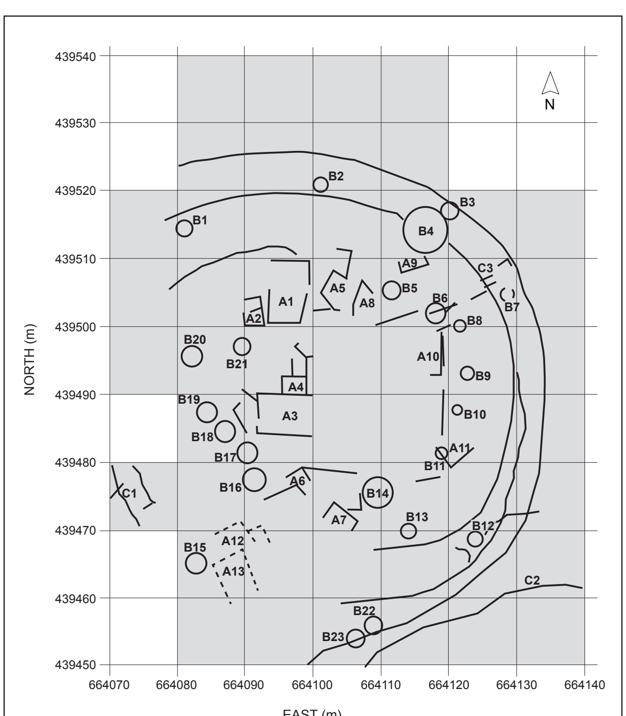


Figure 6.3. Diagrammatic interpretation of geomagnetic anomalies at Vésztő-Bikeri. Anomalies A1–A13 denote structures. Anomalies B1–B23 are monopole- or dipole-type anomalies marking archaeological features and/or metal fragments. B4 marks a steel rod that was used as the site datum during excavations. Anomalies C1–C3 are vague archaeological or geological features. *Figure by Apostolos Sarris and Jill Seagard.*

The weaker monopole anomalies B16, B17, B18, B20, and B21, which are all located slightly downslope along the western edge of the feature concentration in the center of the site, have been identified as pits or small ovens, kilns, or hearths. Similar features can be suggested for anomalies B6, B8, B9, and B10.

Generally, the magnetic map indicates that most pits are located in a concentric zone immediately surrounding the central structures at Vésztő-Bikeri. A few other, isolated anomalies lie outside this central cluster. Several of them (B2, B7, B12, B22, and B23) are located within the inner and outer ditches, and two of them (B7 and B12) may be related to entrances to the Early Copper Age village. Anomaly C3, near B7, may also mark an entryway through the palisade and ditches.

Körösladány-Bikeri

Based upon the successful results of the magnetic survey at Vésztő-Bikeri, geomagnetic studies continued at the neighboring Early Copper Age settlement of Körösladány-Bikeri, which lies on a small ridge, just 70 m west of Vésztő-Bikeri across the Dió Creek canal (see Figure 1.2).

The two Early Copper Age villages are nearly identical in size. In addition to Tiszapolgár material, surface collections at Körösladány-Bikeri resulted in ceramics dating to the Middle Copper Age (Bodrogkeresztúr culture, circa 4000–3500 cal BC), the Late Bronze Age (Gáva culture, circa 1300–900 cal BC), the Sarmatian period (second to fourth century AD), and the Árpádian Age (eleventh to thirteenth century AD; Ecsedy et al. 1982; Parkinson 2006a; Parkinson et al. 2004b; see also Chapter 4, this volume). The two 2 x 2 m test excavation units opened at the site by the Körös Regional Archaeological Project in 2001 contained Early Copper Age ceramics, but no features were identified (see Chapter 7, this volume). Geophysical prospection was initiated in 2003 to identify residues of human activities and to explore the structural relationship between Körösladány-Bikeri and Vésztő-Bikeri (Sarris 2004). A magnetometer survey over an area of 5,600 m² revealed the layout of the site.

Results of Geophysical Surveys at Körösladány-Bikeri

A gradual drift of the magnetic measurements toward the northern and western sections of the site was noticed in the raw magnetic readings, similar to the case at Vésztő-Bikeri. Still, the subtle traces of a system of double or even triple circular ditches became evident even from the

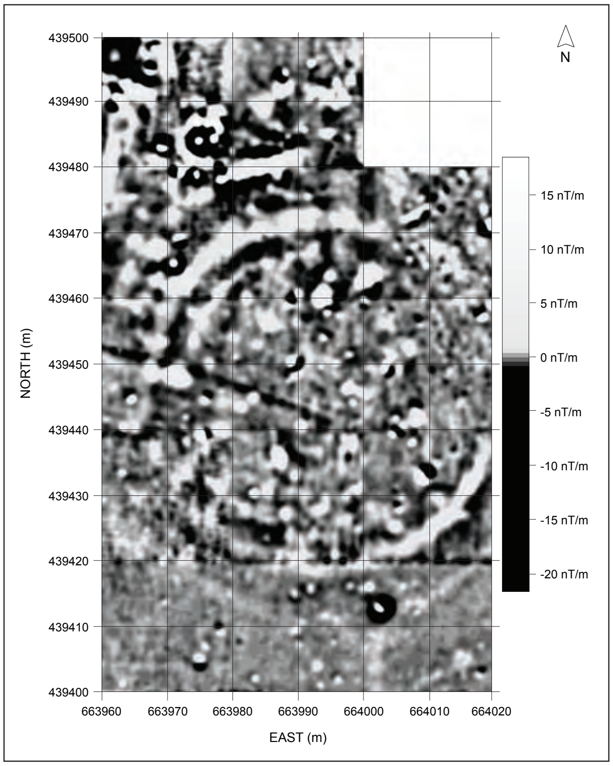


Figure 6.4. Results of high-resolution magnetic surveys at Körösladány-Bikeri showing the magnetic gradient generated by rectified measurements at 0.5 m sampling. *Figure by Apostolos Sarris and Jill Seagard.*

raw data. The original range of magnetic values (-130 to 135 nT/m), mainly caused by extreme value features in the northwestern section of the site, was compressed within various ranges, aiming to enhance the subtle magnetic signals, especially those arising from the system of circular ditches that enclose the site (Figures 6.4–6.5).

The middle ditch is the most evident of all, creating a signal on the order of 1–7 nT/m, a positive anomaly with respect to the background. Similar positive anomalies are associated with the other two ditches. A diameter of about 50 m and a width of about 2–2.5 m were estimated for the middle ditch. The narrow inner ditch lies about 4–5 m from the middle ditch, and the outer ditch is located about 10 m from the middle one, with a diameter of about 70 m.

These three concentric circular ditches (K1, K2, and K3) are much clearer in the northern, western, and southern sections of the site, and they become less obvious toward the eastern part of the geophysical map (Figure 6.5). The inner and outer ditches are approximately 1 m in width (the outer one shows a larger width toward the northwest) and exhibit a nonuniform magnetic intensity, probably originating from internal features, such as postholes. The magnetic signatures of the ditches at Körösladány-Bikeri are much better defined than those at Vésztő-Bikeri and display a slightly higher magnetic signal with respect to the background. The fading signal of the ditches to the east coincides with a similar pattern recognized at Vésztő-Bikeri toward the west and southwest (see above). Thus it is probable that the ditches of both Early Copper Age sites were partially eroded either due to heavy cultivation at the edge of the ridges or subsequent floods of the Dió Creek.

Subsequent excavations verified the locations of the concentric ditches. The middle ditch and the outermost ditch proved to be trapezoidal in cross-section (Figure 6.5; see Chapters 7 and 8, this volume). The narrower inner ditch was similar to the inner ditch with the palisade at Vésztő-Bikeri, containing large postholes.

A low-intensity (-1 to 0 nT/m) linear anomaly (K4) located on the western part of the site runs in a diagonal, northwest–southeast direction for more than 38 m. It seems to start at the center of the site, and after crossing

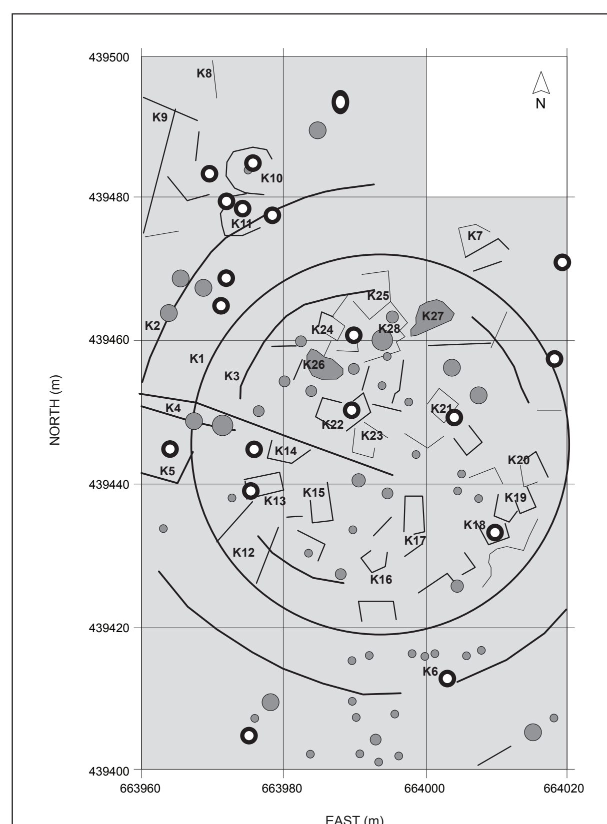


Figure 6.5. Diagrammatic interpretation of geomagnetic anomalies at Körösladány-Bikeri. Black-and-white circles indicate monopole- or dipole-type anomalies. *Figure by Apostolos Sarris and Jill Seagard.*

the ditches it runs toward the edge of the geophysical grid. The segments of this 1 m–wide linear anomaly that cross the inner and middle ditches are characterized by high-intensity monopole anomalies. The K4 anomaly may mark a narrow path running out of the village. Similarly, anomalies K5, K12, and K18 suggest interruptions that may have been entryways through the palisade and ditches.

Although the application of filters, such as directional derivatives, offers evidence for rectangular features in the southern part of the settlement, there are no well-defined signals for structures like those identified at Vésztő-Bikeri. Because the strong magnetic signals from the architectural remains at Vésztő-Bikeri can be related to burned rubbles associated with the structures, it is possible that the lack of similar signals at Körösladány-Bikeri suggests only a few, less intensive burning episodes. In contrast to Vésztő-Bikeri, most architectural remains at Körösladány-Bikeri, as suggested by anomalies K13, K14, K15, K16, K17, K19, K20, K21, K23, and K24, are interpreted as small, less than 5 x 3 m, randomly aligned, dispersed structures that exhibit weak magnetic signals.

A few monopole or dipole magnetic anomalies at Körösladány-Bikeri can be identified either as pits, kilns, or hearths. The high vertical magnetic gradient dipole anomalies at K10, K11 (-130 to 135 nT/m), K22 (-112, 91 nT/m), K18 (-55, 40 nT/m), and K6 (-70, 164 nT/m) indicate metal objects. The area in the vicinity of anomalies K10 and K11 seems to be contaminated with metal residues. Other strong (medium-strength), isolated anomalies, such as K26, K27, and K28, are within the limits of the site, mainly in the northern section, and they may be related to extensive pits or kilns, possibly related to a workshop area.

Vésztő-Mágor

The Vésztő-Mágor tell lies northwest of the town of Vésztő, on the bank of a pre-regulation Sebes-Körös River channel (see Figure 1.2). The tell covers an area of about 4.7 ha and rises to a height of nearly 9 m. Previous excavations revealed a stratigraphy of about 4.5–7 m and confirmed that the site initially was settled during the late Middle Neolithic (Szakálhát phase), with a continuous occupation during the Late Neolithic (Tisza phase; Figure 6.6). A buried soil layer signifies the abandonment of the Neolithic site until the establishment of an Early Copper Age Tiszapolgár culture settlement, possibly followed by an occupation during the Middle Copper Age Bodrogkeresztúr phase. After another significant hiatus, the tell was reoccupied during the Middle Bronze Age Gyulavarsánd period (circa 1800–1300 cal BC; Hegedűs 1982; Hegedűs and Makkay 1987; Makkay 2004).

During the Árpádian Age, a monastery of the Csolt clan was constructed on the tell; it continued to operate from the eleventh century until the end of the fourteenth century while undergoing several different construction phases. In the early nineteenth century, the Wenckheim family built a wine cellar under the remaining foundations of the monastery (Hegedűs and Makkay 1987; Makkay 2004). The first systematic archaeological activities at the site, which were initiated in 1968 by Nagy and continued later by Juhász, focused on the monastery. Hegedűs conducted a more extensive excavation to investigate the tell from 1972 to 1976, and Makkay dug a trench in 1986. The results of the excavations have not been published in detail, but the location of Hegedűs's trenches are approximately known (Figure 6.6A). The site became a national park, where one can visit an archaeological museum in the wine cellar, a reconstruction of the monastery, and the open 1986 stratigraphic exhibition.

Vésztő-Mágor is very different from the rest of the sites where geophysical surveys were conducted in the framework of the Körös Regional Archaeological Project. Vésztő-Bikeri is a single-component Tiszapolgár site, while the main occupation phase at Körösladány-Bikeri also dates to the Early Copper Age. The Bikeri villages were similar in size (less than 1 ha), and both were enclosed by a similar ditch and palisade system. In contrast, Vésztő-Mágor is a multicomponent, multiphase tell site that served as a central place in various periods (Figure 6.6B; Parkinson 2006a; Parkinson et al. 2010b).

Results of Geophysical Surveys at Vésztő-Mágor

The geophysical survey at Vésztő-Mágor was carried out in 2006, using both Geoscan FM36/256 and Bartington G601 gradiometers, covering an area of 46,600 m² (Sarris 2006). Due to the reconstructed monastery and other modern features, the top of the tell was not investigated (Figure 6.7).

The geophysical grids were expanded in the surrounding area, with the exception of a small strip to the east where the causeway leading to the museum is located (Figure 6.7). Increased levels of noise and a high concentration of extreme magnetic features are exhibited within the area of the tell, along with some isolated, strong, vertical magnetic gradient anomalies toward the northeastern part of the surveyed area (Figures 6.8–6.9). The former signals partly are associated with the disturbed soil layers as a result of past excavations and

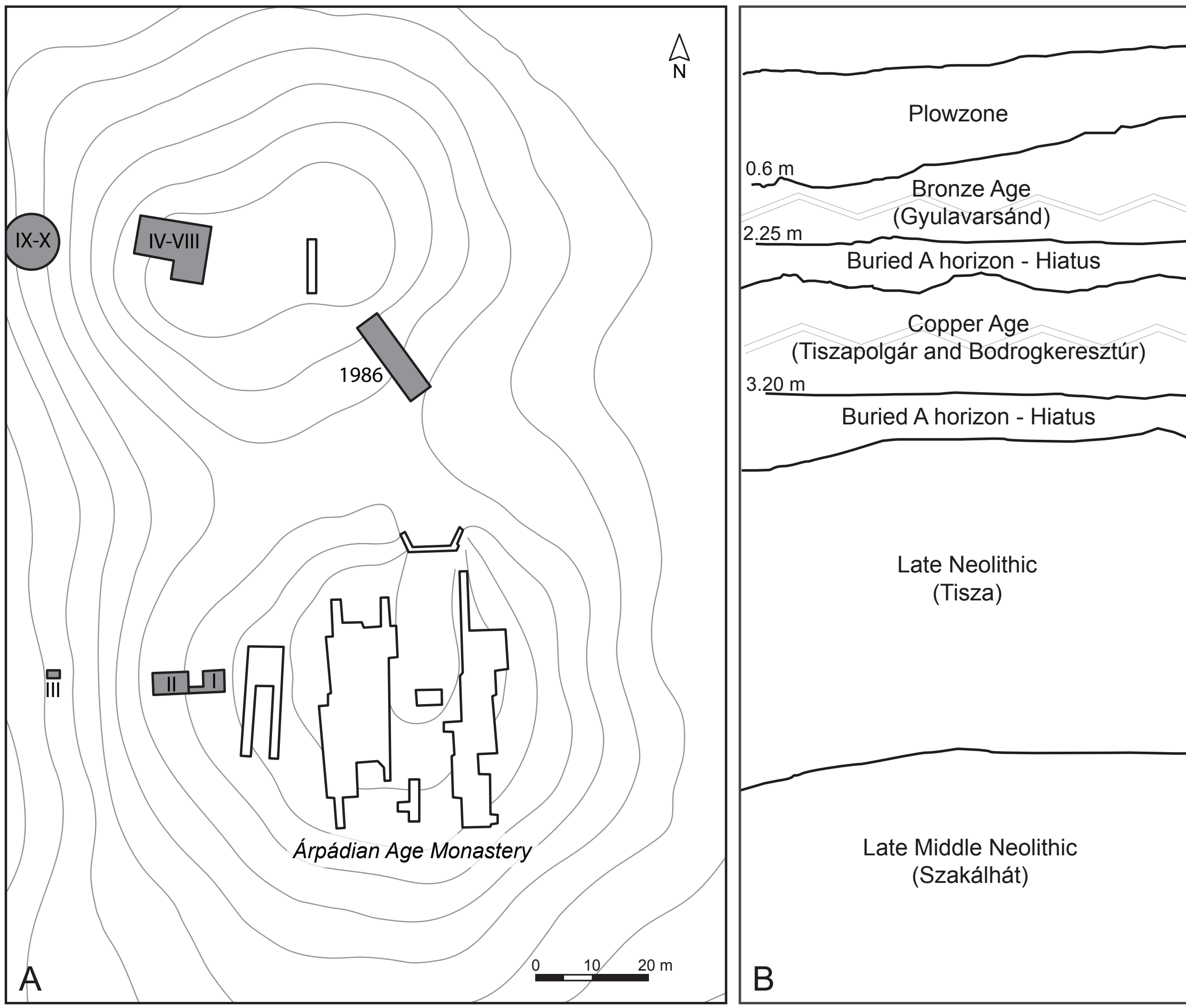


Figure 6.6. Map and stratigraphy of the Vésztő-Mágor tell. A: Topographic map showing the location of excavation trenches and the Árpádian Age monastery. Roman numerals indicate trenches excavated by Hegedűs (I–X) and Makkay (1986). Map based on Hegedűs and Makkay (1987:86); B: Schematic of stratigraphic sequence in the north profile of Hegedűs's Trenches IV–V. Based on Hegedűs and Makkay (1987:86). *Figure by Jill Seagard.*

construction works both in historic and modern times. It is unclear whether these features are related to archaeological features. Two parallel trenches running in a southwest–northeast direction are visible to the north and northwest of the settlement mound. The trenches continue with a different orientation along the smooth slopes of the tell.

The application of directional derivatives was successful in recognizing linear features and pinpointing the most intensive anomalies of interest. Directional filtering enhanced the linear features extending in a direction perpendicular to that of the corresponding directional filters, and most of the extensive linear anomalies were identified at the southern, eastern, and northern lower slopes of the tell. In addition to the aforementioned edge detection techniques, a number of high-pass filters were applied to the original vertical magnetic gradient measurements (Figure 6.8). A 3 x 3 high-pass filter was used to sharpen the measurements. Other edge detection filters, such as Roberts row detector and FreiChen column detector filters, also were utilized. The latter was extremely successful in enhancing a subtle anomaly toward the northeastern section of the geophysical survey area; the feature is circular in shape and measures 20 m in diameter. It does not seem to

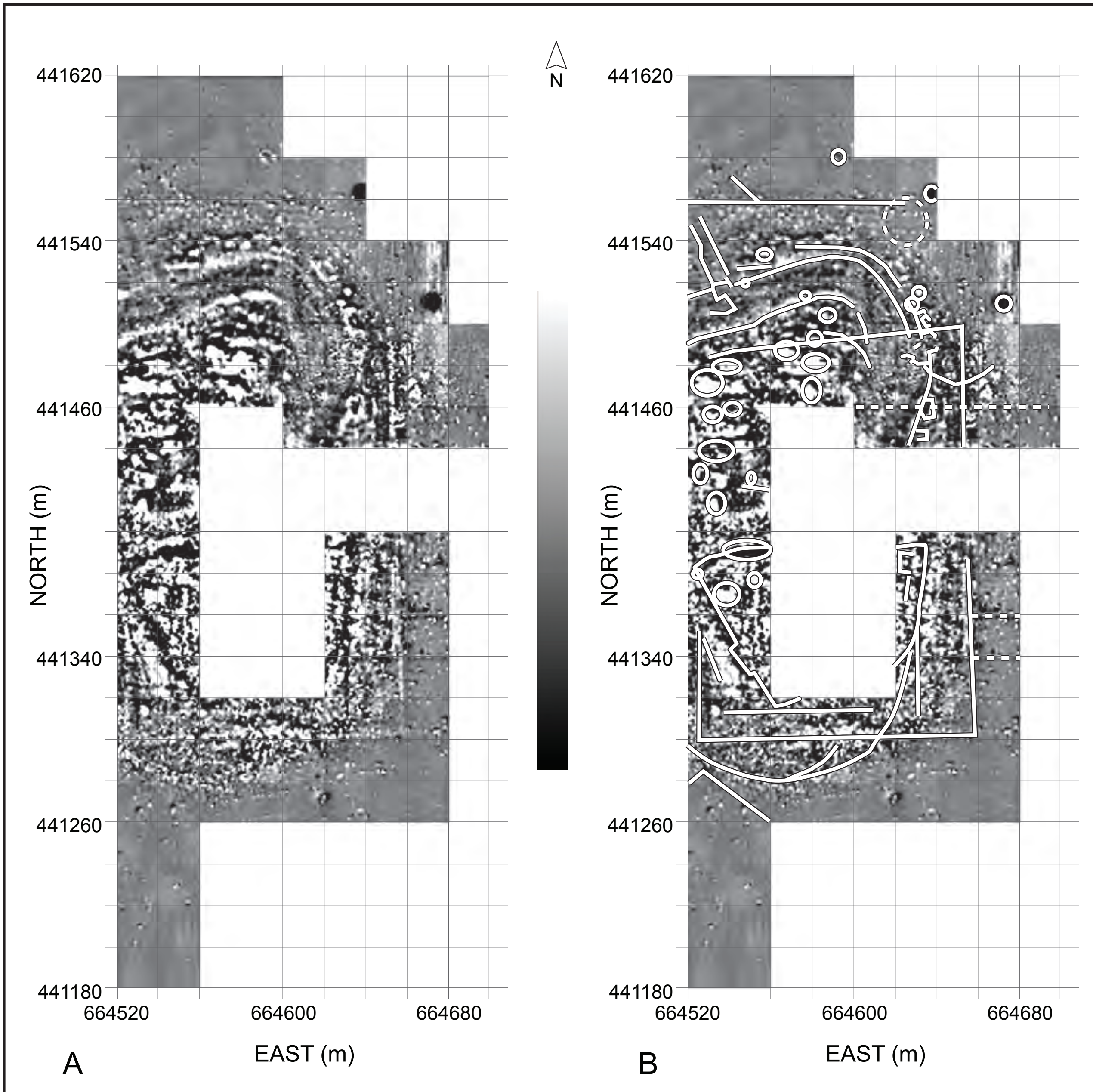


Figure 6.7. Results (A) and interpretation (B) of high-resolution magnetic surveys at Vésztő-Mágor showing the magnetic gradient generated by rectified measurements at 0.5 m sampling. *Figure by Apostolos Sarris and Jill Seagard.*

be related to other anomalies and may be associated with either a different, probably more recent occupation phase or recent agricultural activities.

The data also were subjected to compression of the dynamic range of the original measurements, which demonstrates clearly the presence of numerous metal objects in the vicinity of the survey area (for example, wells, topographic datum points; see Figure 6.8). Thus the de-spiked range of +/-16 nT/m was compressed down to +/-2 nT/m, emphasizing the subtle anomalies. The synthetic correlation of the above maps was used for the final interpretation of the magnetic anomalies. Figure 6.9 shows the diagrammatic interpretation of the magnetic data, where the most significant anomalies are coded with M followed by a number (M1, M2, and so on), and the isolated or fuzzy anomalies are marked with a lowercase letter (a, b, and so on).

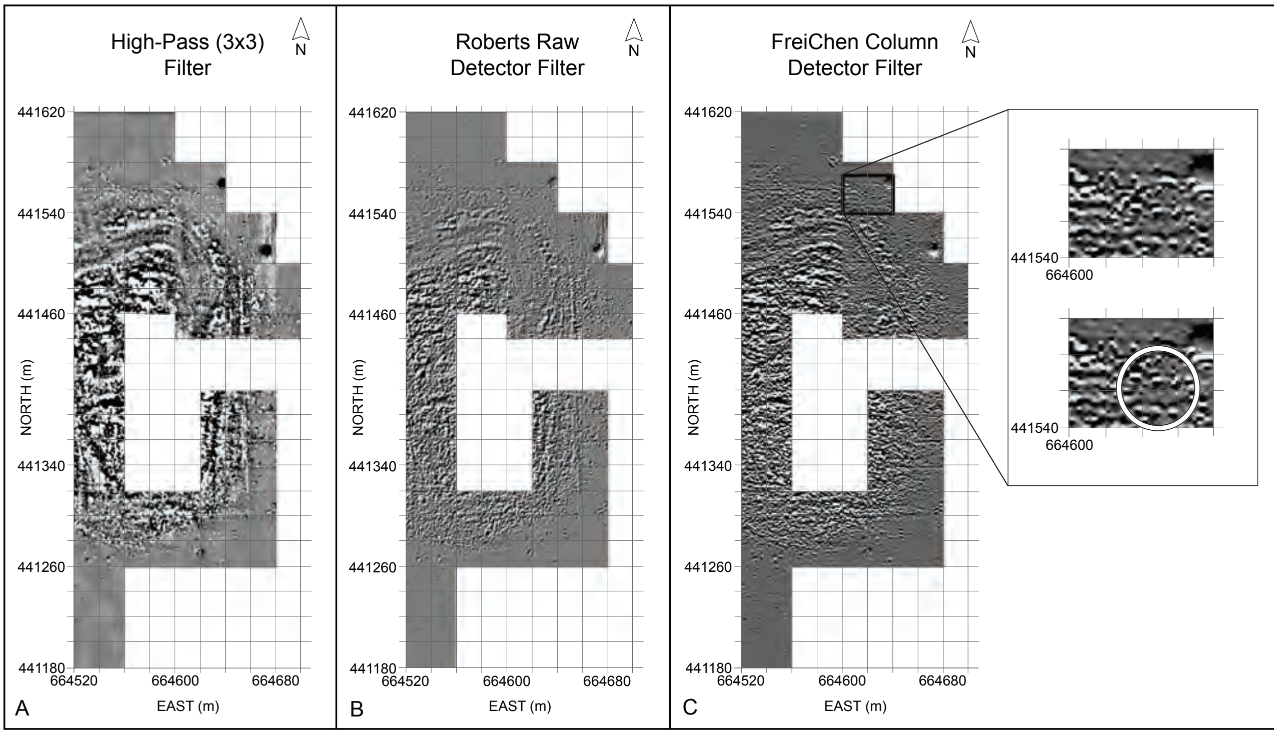


Figure 6.8. Application of high-pass (A) and edge detection filters (B and C) to the vertical magnetic gradient measurements from Vésztő-Mágor. Inset on the right shows a circular feature of about 20 m in diameter located north of the tell. *Figure by Apostolos Sarris and Jill Seagard.*

A number of features became apparent as a result of the above processes. Above all, the most significant features are curvilinear ditches that surround the northern section of the site and a rectangular feature that encloses the entire Vésztő-Mágor tell (Figure 6.9). The system of curvilinear ditches is better defined in the northern section, running northeast–southwest and then curving and changing to northwest–southeast in the eastern section. The outer ditch is designated as anomaly M6. The inner ditch (anomaly M7) runs parallel with the outer ditch, about 20 m to the south. Thin strips of low vertical magnetic gradient values were noticed between the two ditches, specifically to the south of M6 and to the north of M7. A closer look at the specific anomalies suggests that they consist of isolated, smaller features that may be identified as postholes, possibly parts of a palisade. About 2–3 m to the north of M6, a third ditch (M5), especially evident to the northeast, also is recognizable. As opposed to M6 and M7, whose signals fade away, this particular feature can be traced farther to the south, and it seems to align in a northeast–southwest direction (M8) as it approaches the causeway that leads to the museum. The northwestern course of ditch M6 seems to be interrupted by a wide strip (M3) running in a direction perpendicular to M6, namely northwest–southeast. This strip, although it does not continue farther to the south toward ditch M7, may mark a possible gate.

The projection of the ditches to the south is not well defined. Most of the interior anomalies to the south of the north ditches are fuzzy and lack any clear geometry. Several of them (such as i, k, l, m, p, s, t, and w) extend over a large area, and it is possible that some represent past excavation trenches or other historical or modern disturbances and construction works. By a crude georeferencing routine using the plan of excavation trenches provided by Hegedűs and Makkay (1987:86; see Figure 6.8) and based on the elevation isolines and the location of the 1986 excavation trench, it was possible to identify the approximate location of Hegedűs's excavation trenches I and II with anomalies w and v, whereas anomalies l, m, and n likely represent Hegedűs's trenches IV–VIII.

The symmetry and pattern of curvilinear features are not so obvious to the south. A curvilinear feature (M22) extends from the southern edge of the tell for at least 100 m in an east–west direction and then turns and continues farther north (M19). A possible rectangular feature (M20) is indicated on the northwestern edge of anomaly M19, close to the museum. The whole image of the southern side of the tell becomes even more complicated due to the presence

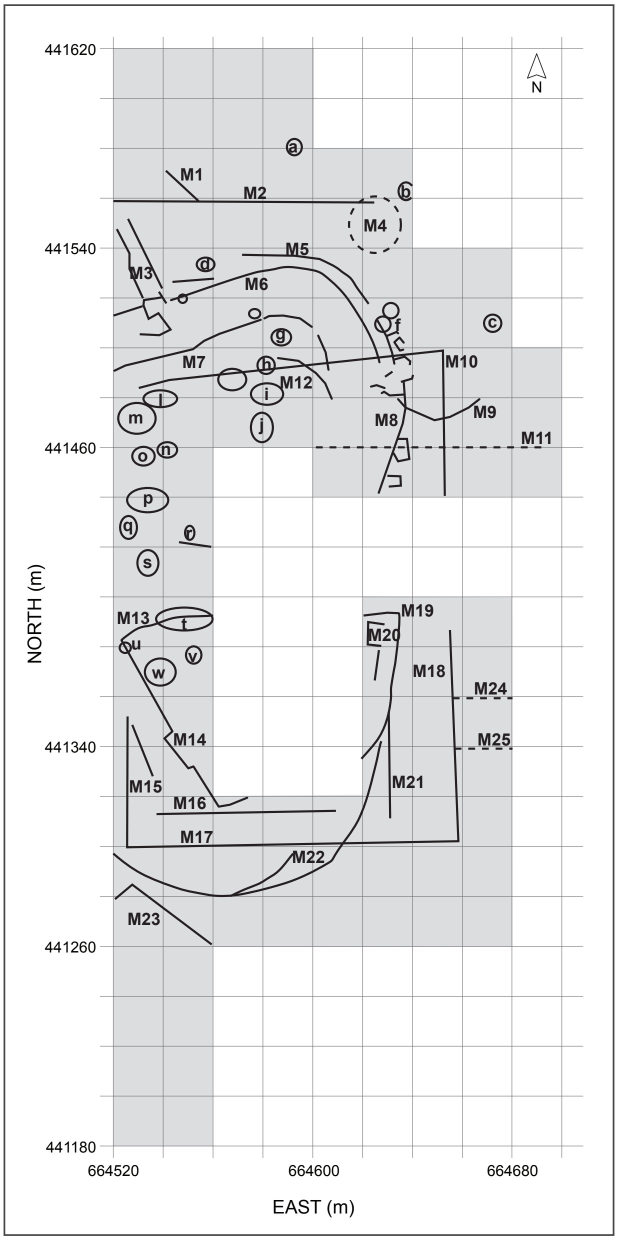


Figure 6.9. Diagrammatic interpretation of geomagnetic anomalies from Vésztő-Mágor. Significant anomalies are indicated by M followed by a number. Isolated anomalies are indicated by lowercase letters. *Figure by Apostolos Sarris and Jill Seagard.*

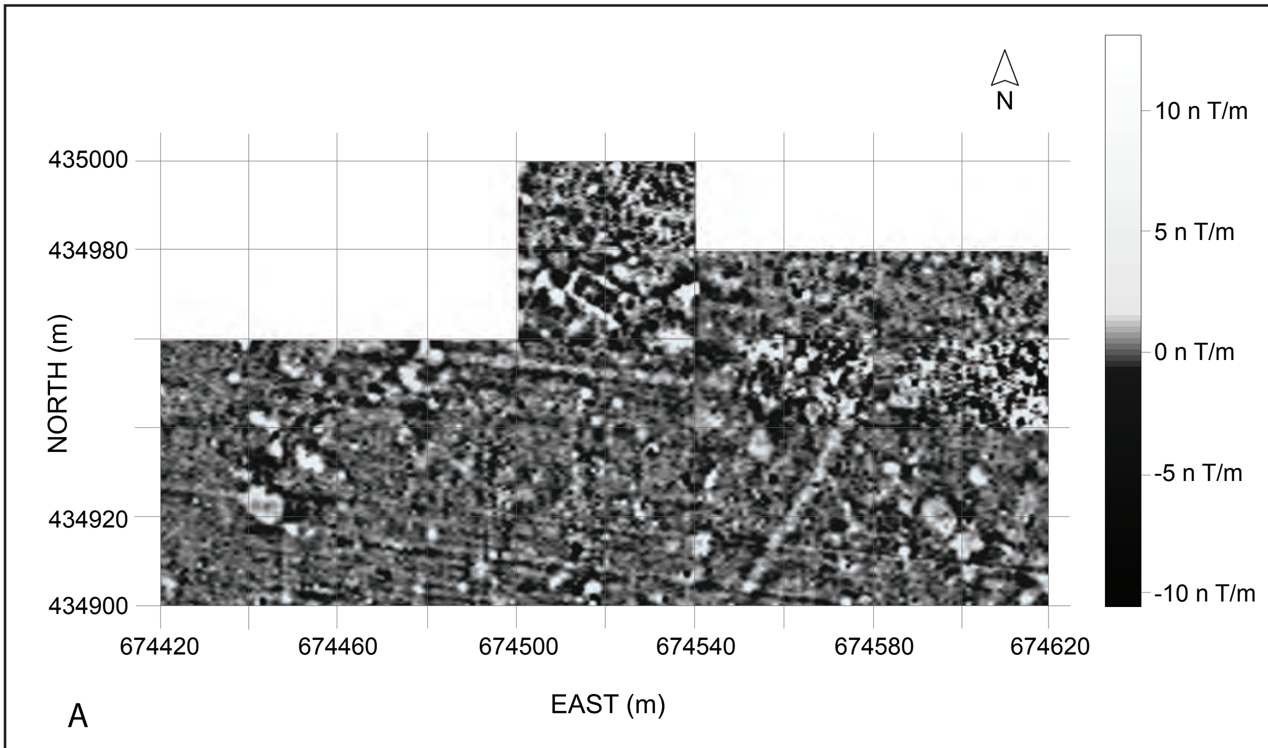
of the strongly magnetic segments of M14 and M13 on the southwestern slopes of the tell. The magnetic signatures of M14 and M13 are similar to M19. In contrast, the curvilinear anomaly of M22 is more subtle than all the above, even when compared to the corresponding trenches (M5, M6, and M7) on the northern section of the tell. If we consider that M13, M14, and M19 are parts of the same entity, then they may represent the inner boundaries of the monastery facilities, possibly the monastery yard. This may further be supported by the fact that both M14 and M19 run along the same elevation line of 87.5–88 masl.

Anomalies M15, M17, M18, M10, and M2 constitute another significant feature at the Vésztő-Mágor tell. This well-defined, rectangular feature outlines an area of approximately 135 x 260 m and encloses the entire site. The feature is clearly defined toward the southwest, south, and east, but its traces become invisible in the northeast and west (Figure 6.9). This feature appears unrelated to the curvilinear anomalies discussed above, and perhaps it signifies the boundaries of the property during the last phases in the history of the Csolt monastery. These boundaries, probably walls, produced a high vertical magnetic gradient anomaly similar to the curvilinear ditches to the north. In contrast to the width of the ditches, which seem to vary between 3 and 4.5 m, this anomaly is less than 1.5 m wide and encloses the Vésztő-Mágor tell at 85.3–86 masl, whereas the ditches in the north are located higher, at 86.5–88 masl. The latter elevation range is different from the elevation of the southern curvilinear anomaly (M22), which is located on the flat area extending even beyond the walls that might have confined the monastery grounds. On the other hand, the continuation of M22 to the east seems to progress along the slope of the tell up to an elevation of 87.5 masl.

More subtle anomalies are also indicated by the magnetic data. One of them, anomaly M23, is located south of M22 and represents an approximately 41 m–long linear segment that extends in a northeast–southwest direction. There also is evidence for a change in the direction of M23 toward its northwestern edge. Another anomaly (M4), located to the northeast, was pinpointed by the application of the FreiChen column detector filter. The northern segment of the probable monastery precinct walls (M2) appears to cross the northern part of this circular feature, and thus M4 might belong to a different time period. Finally, a few other anomalies can be correlated with surface features (for example, feature c is a small well).

Okány-Futás

Okány-Futás lies on a low ridge about 150 m southeast of an abandoned meander of the pre-regulation Sebes-Körös River (see Figure 1.2). Ecsedy et al. (1982:136) reported daub and Early Copper Age ceramics at the location. The site was revisited by Parkinson in 1998 (Parkinson 2006a:112–13). The densest artifact distribution was concentrated in an area of about 0.21 ha, while a more



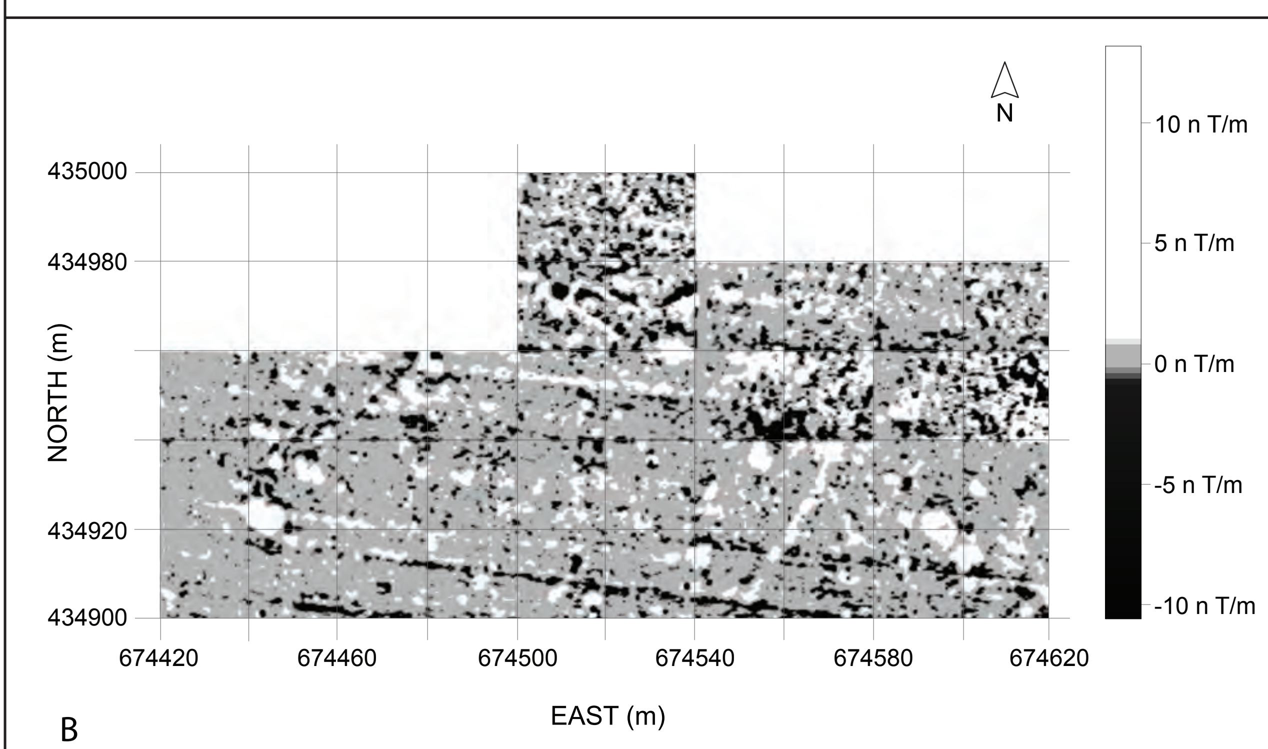


Figure 6.10. Results of high-resolution magnetic surveys conducted in 0.5 m intervals transects located 1 m apart at Okány-Futás. A: De-spiked, smoothed, vertical magnetic gradient values; B: Compressed dynamic range emphasizing extreme values. *Figure by Apostolos Sarris and Jill Seagard.*

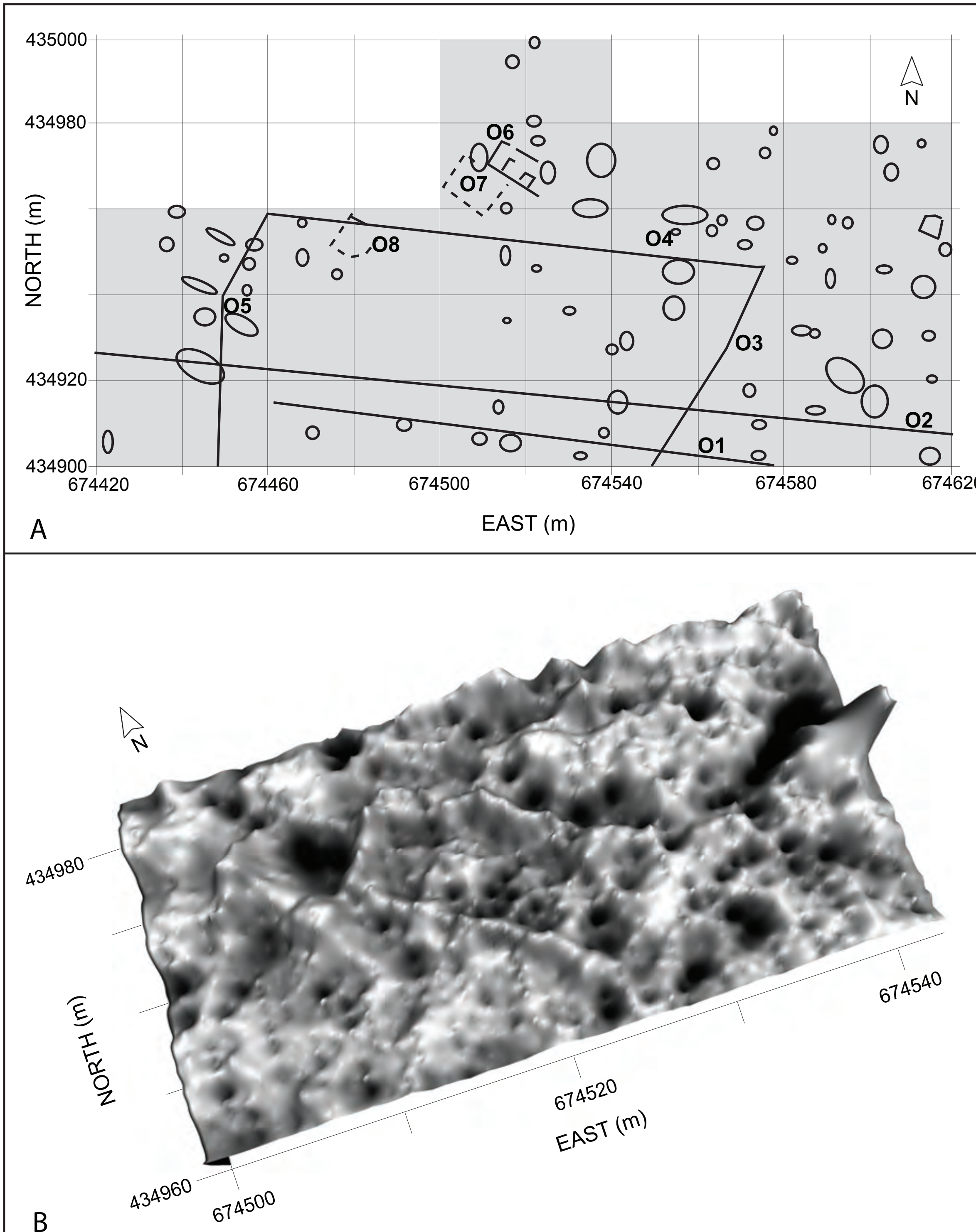


Figure 6.11. Results of high-resolution magnetic surveys at Okány-Futás. A: Diagrammatic interpretation of geomagnetic anomalies from Okány-Futás; B: 3D representation of a section of the magnetic data that covers anomalies O6 and O7 at Okány-Futás. *Figure by Apostolos Sarris and Jill Seagard.*

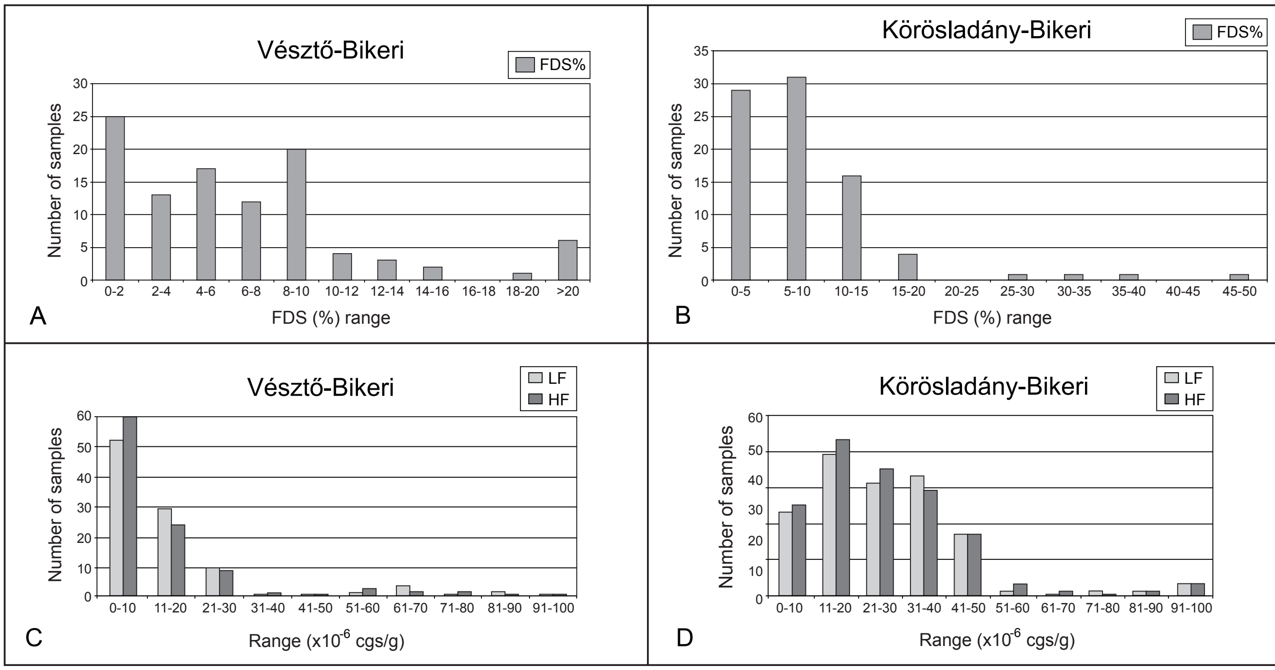


Figure 6.12. Histograms of frequency dependent susceptibility (FDS; A and B) and soil magnetic susceptibility values (C and D) from Vésztő-Bikeri (A and C) and Körösladány-Bikeri (B and D). LF indicates low frequency values and HF indicates high frequency values. *Figure by Apostolos Sarris and Jill Seagard.*

dispersed scatter covered 0.6 ha. Most of the ceramics collected date to the Early Copper Age, although several of them date to the Migration period (fifth to sixth century AD). In 2006, the Körös Regional Archaeological Project conducted systematic, intensive, gridded surface collections, and magnetometry, whereas geochemistry sampling was performed in 2006 and 2007 (Parkinson et al. 2004a, 2004b, 2010b; Salisbury 2016; Yerkes et al. 2007; see also Chapters 4 and 5, this volume). In 2006, the site was covered with different cultivated crops: alfalfa in the southern and eastern sections, corn in the middle section, and wheat in the north.

Results of Geophysical Surveys at Okány-Futás

At Okány-Futás, the magnetic survey, carried out with Geoscan FM36/256, covered an area of 15,200 m² (Sarris 2006). The original range of the magnetic readings was between -29 and 104 nT/m, reduced to a range of +/-15 nT/m after de-spiking. Extreme bipolar magnetic values were indicated toward the northern section of the area, and a few more clusters of high values were located in the east and west sections (Figures 6.10–6.11).

Surface collections indicated that there are modern features in the survey area, especially in the eastern section. A few prominent linear anomalies (such as O1, O2, and O4) extending in a southeast–northwest direction and a couple more (O3 and O5) extending in a perpendicular direction are evident in the geophysical map and most probably designate previous field boundaries (Figure 6.11A). Weaker linear features that run in a northwest–southeast direction and are limited to the south section of the geophysical grids suggest plowing patterns in the field. Compression of the original dynamic range down to +/-1 nT/m enhanced the weaker signals in the survey grids.

The most distinct anomaly is O6, oriented in a northwest–southeast direction (Figure 6.11). The anomaly represents the remains of a structure with dimensions of 10 x 7 m. The outer walls of the feature exhibit high values in the vertical magnetic gradient. The northeastern wall ends in a circular anomaly. There is a dipolar anomaly outside the southwestern corner of the structure. Both of these anomalies suggest the presence of residues from burning. The magnetic attributes of features located inside the structure indicate that it may consist of more than one room. Outside the southwestern corner, another rectangular feature of

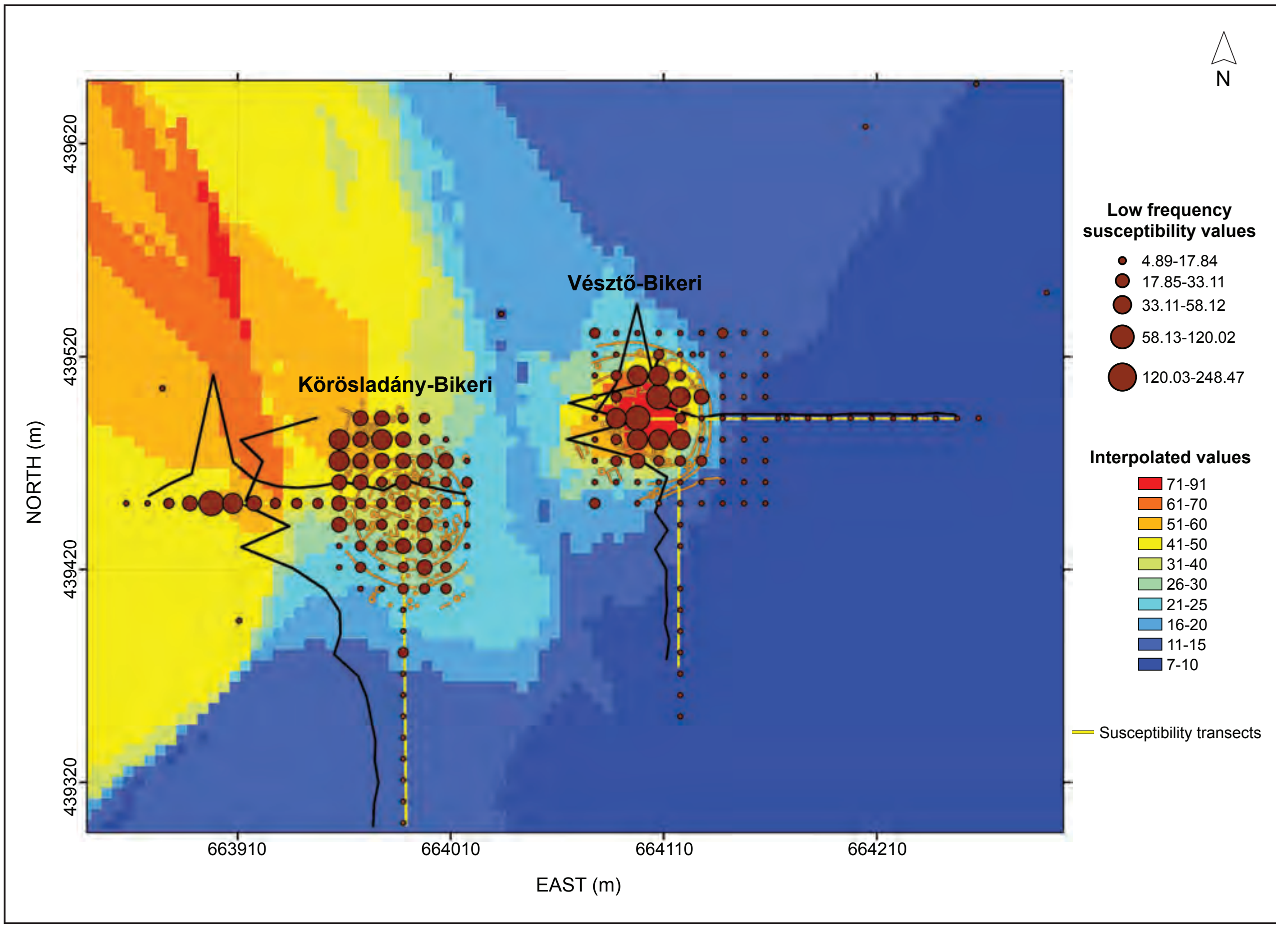


Figure 6.13. Surface distribution of low frequency (LF) magnetic susceptibility values at Vésztő-Bikeri and Körösladány-Bikeri. LF susceptibility values are indicated by circles. The interpolated distribution is indicated in the underlying color map. *Figure by Apostolos Sarris.*

lower magnetic strength is visible (O7; Figure 6.11B). It has the same orientation as O6 and similar dimensions (about 10 x 9 m).

Another anomaly, O8, also may mark the location of a structure. This anomaly, however, lacks the clear geometric attributes of O6 and O7, although it is less diffuse than the other isolated anomalies at the site. Some of these larger and diffuse anomalies deserve further attention.

Magnetic Susceptibility at the Bikeri Sites

The majority of soil samples collected at Vésztő-Bikeri have lower magnetic susceptibility levels compared to those of Körösladány-Bikeri. In fact, 93 percent of samples from Vésztő-Bikeri are below the level of 30 x 10^{-6} cgs/g, and only 16 percent exhibit high FDS (more than 10 percent, whereas 64 percent of soil samples from Körösladány-Bikeri are below that level, and 28 percent exhibit high FDS (Figure 6.12).

The surface distribution of magnetic susceptibility at Vésztő-Bikeri exhibits a dense concentration of high values within the enclosure, decaying to background values outside the concentric ditches (Figure 6.13; Sarris and Catanoso 2005). Similar high values are shown for the FDS, which reaches its peak at the edges of the settlement, where the enclosure is located (Figure 6.14). Furthermore, the FDS exhibits a trend of relatively higher values toward the west. It is possible that this kind of halo of relative high values of FDS to the west was caused by past flooding episodes, depositing material from the settlement to the west–north-west, along the path of the current drainage ditch.

A different pattern is indicated by the susceptibility measurements from Körösladány-Bikeri. Although the levels of magnetic susceptibility generally are higher at this site than at Vésztő-Bikeri, the highest values are not

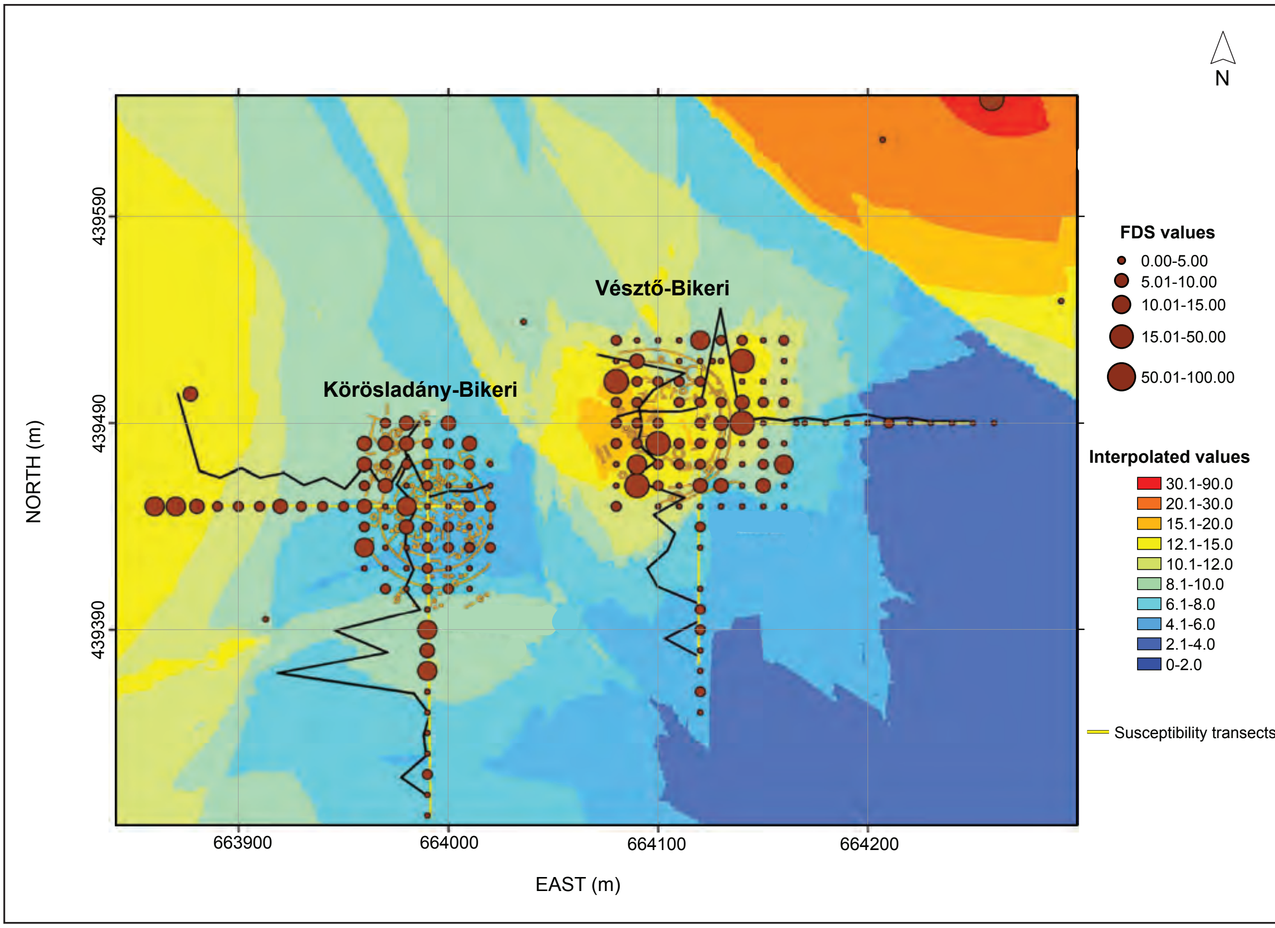


Figure 6.14. Surface distribution of frequency dependent susceptibility (FDS) values at Vésztő-Bikeri and Körösladány-Bikeri. FDS values are indicated by circles. The interpolated distribution is indicated in the underlying color map. *Figure by Apostolos Sarris.*

located within the limits of the settlement but rather are outside, concentrating in the northwest and west, where a cluster of high vertical gradient dipole magnetic anomalies (-130 to 135 nT/m) were recorded. These values may represent kilns or ovens located outside the Early Copper Age settlement, or they may be associated with the Late Bronze Age and Sarmatian components of the site. The weaker magnetic signals in the interior of the settlement may be caused either by the more ephemeral Early Copper Age habitation of the settlement, as may be suggested by the lack of large structures, or the lack of intensive burning of the structures. Furthermore, susceptibility measurements along the north–south and east–west transects across and beyond the Körösladány-Bikeri site do not define the limits of the settlement as clearly as they did at Vésztő-Bikeri. In contrast, the peak values along the east–west transects are located about 60–100 m to the west of the enclosure. Similar results were obtained for the FDS to the south (20–40 m to the south; see Yerkes et al. 2007). These peaks may be associated with off-site Early Copper Age activities or perhaps with the later phases of activity in the area.

Conclusions

During the magnetic prospection surveys, the measurement of the vertical magnetic gradient in the grids at all the investigated sites produced a wealth of recognizable subsurface features. These data provided information regarding the location and organization of Early Copper Age settlements in the study area and were used to identify targets for excavations at selected locations within the sites.

At Vésztő-Bikeri, a concentration of *pisé de terre* and wattle-and-daub structures was revealed at the center of the site. These features are flanked on the east and west by kilns, ovens, hearths, and pits, and several of them were exposed during the excavations at the site (Gyucha et al. 2004, 2006; Parkinson et al. 2004a, 2004b, 2010b; Sarris et al. 2004; Yerkes et al. 2007, 2009; see also Chapters 7 and 8, this volume). The central clustering of large longhouse structures at Vésztő-Bikeri and their radiocarbon dates indicate continuity between Late Neolithic and Early Copper Age construction practices in the Körös region. Concentrations of burned daub and ceramic artifacts on the surface spatially coincided with the houses, but there were no visible traces of the large, concentric, circular ditches that enclosed the village on the modern surface. These important features initially were identified by the magnetic survey. The ditch-and-palisade enclosures at both Vésztő-Bikeri and Körösladány-Bikeri indicate that, as at Late Neolithic tell sites, defensive features were constructed around small dispersed settlements during the Early Copper Age. More recent research from other parts of the Great Hungarian Plain indicates that this also occurred elsewhere (Raczky and Anders 2012). The lack of intensive magnetic features between the central structural remains and the enclosure at Vésztő-Bikeri suggests that the outer zone of the village may have been used for keeping animals and dumping trash. This pattern is less clear at Körösladány-Bikeri.

High phosphorus concentrations outside the central living areas at both Bikeri villages also suggest that there were animal pens or middens in the outer settlement zones (Salisbury 2016; Sarris et al. 2004; Yerkes et al. 2007; see also Chapter 5, this volume). This pattern fits the model for agricultural settlements where organic waste was removed from living quarters and deposited in midden areas near site edges (e.g., Killion 1992). Conversely, low phosphorus levels in the vicinity of the structures seem to indicate that organic waste was not a constituent of the daub that covered building walls. Similarly, moderate levels of phosphorus were recorded close to magnetic targets identified as kilns, ovens, pits, or hearths (see Figures 5.3 and 6.3; anomalies B9, B10, B16, B17, B18, B19, B20, and B21), suggesting that not much organic refuse accumulated near these features. Breaks in high-value phosphate contours around the perimeters of the Bikeri sites correlate well with both the vertical magnetic gradient and magnetic susceptibility values and may represent entryways to the settlements (Parkinson et al. 2004b, 2010b; Sarris 2004; Yerkes et al. 2007). These common patterns indicate fundamental similarities in the layout and use of Early Copper Age agricultural settlements on the Great Hungarian Plain.

The fading signal for the circular ditches in the eastern part of Körösladány-Bikeri is in agreement with a similar pattern noticed in the western and southwestern perimeters of Vésztő-Bikeri and indicates that the enclosures of both settlements were eroded due to agricultural activities or repeating floods of the Dió Creek. The interior of the Körösladány-Bikeri settlement shows evidence of pits and other small features, most of which have dimensions of less than 3 x 5 m. These structures are not as clearly defined as the longhouses at Vésztő-Bikeri. This may suggest the absence of burning episodes, or perhaps just less intense burning events, at Körösladány-Bikeri. A rectangular, high-gradient anomaly marked the location of several large, bell-shaped Tiszapolgár storage or refuse pits and two infant burials. A deep well or cistern also was identified during the magnetic survey (see Chapters 7 and 8, this volume). Finally, a few widespread, high-intensity anomalies in the northern section of Körösladány-Bikeri may be related to workshop activities (for example, kilns). In contrast to Vésztő-Bikeri, there is no evidence of a distinct, central concentration of houses or activity areas, which may suggest some changes in settlement organization by the later phase of the Early Copper Age. In addition, excavations at the locations of large monopole anomalies revealed several later features at Körösladány-Bikeri, including large Sarmatian pits and Late Bronze Age features (see Chapters 7 and 8, this volume).

The magnetic prospection surveys at the Vésztő-Mágor tell and the Okány-Futás hamlet brought about significantly different results than those of Vésztő-Bikeri and Körösladány-Bikeri. The survey at the Vésztő-Mágor tell was challenging due to subsequent occupation phases from the Middle Neolithic to the Middle Ages. At Okány-Futás, modern plowing created increased noise levels. While the system of concentric ditches surrounding Vésztő-Mágor is similar to the pattern experienced at Vésztő-Bikeri and Körösladány-Bikeri, the Vésztő-Mágor features were constructed at a much larger scale. Also, the enclosure around the tell at Vésztő-Mágor is not circular but rather sub-rectangular in shape, probably because it was constructed to surround the Neolithic settlement at the site.

The magnetic survey at Okány-Futás proved to be less productive than at the Bikeri sites. Still, in spite of the increased noise levels, at least two or three structures were identified by the magnetic prospection at the site. No features indicating enclosures, fortifications, or ditches were found. On the other hand, at least one rectangular structure of 10 x 7 m was clearly recognized. The structure seems to have consisted of at least two rooms. Another structure of similar dimensions is suggested to the south. A third, smaller in dimensions and fuzzier in terms of its geometry, may be located farther to the west. Features that are visible in the northwestern section of the aerial imagery of the site may be correlated with these structures.

The integrated application of nondestructive geophysical techniques, geochemical analyses, systematic surface collections, and targeted excavations is a valuable tool for reconstructing the organization of Early Copper Age settlements in the study area. Geophysical techniques proved to be invaluable in providing new data and guiding the excavations, and they revealed a number of important details about the small, dispersed Early Copper Age agricultural settlements of the Great Hungarian Plain.

Part III

Archaeological Excavations at Vésztő-Bikeri and Körösladány-Bikeri

Chapter 7

Excavation Methods and Results

Richard W. Yerkes, William A. Parkinson, Attila Gyucha, and Margaret Morris Downing

We conducted excavations at Vésztő-Bikeri and Körösladány-Bikeri from 2000 to 2006 to gain insights into Early Copper Age village dynamics within the Körös region. Many systematic excavations had been carried out at Late Neolithic tells and large horizontal sites on the Great Hungarian Plain (e.g., Horváth 2005; Kalicz and Raczky 1984; Raczky 2009; Raczky et al. 2007; Tálas and Raczky 1987), but prior to our work, the majority of excavated Early Copper Age sites were cemeteries (e.g., Bognár-Kutzián 1963; Kovács and Váczi 2007); only a handful of Tiszapolgár settlements had been tested through limited excavations (Bognár-Kutzián 1972; Goldman 1977; Goldman and Szénászky 2012; Mészáros 2007; Patay 2008; Siklódi 1982, 1983; Szilágyi 2010; see also Chapter 1, this volume). The Archaeological Topography of Hungary surveys located and described 394 Early Copper Age sites within 3,798 km² of the Körös–Berettyó drainage system in northern Békés County. These typically small Tiszapolgár culture sites were thought to have very shallow stratigraphy, and it was assumed that most of the features and cultural layers at these sites had been plowed away as a result of intensive agricultural activities (Ecsedy et al. 1982; Jankovich et al. 1989, 1998; Szatmári in prep.). However, surface investigations and geophysical surveys carried out by the Körös Regional Archaeological Project suggested that features and stratigraphic layers were, in fact, preserved intact below the plowzone at some of these Early Copper Age sites (Gyucha 2015; Parkinson 2006a; Sarris et al. 2004; Yerkes et al. 2007; see also Chapters 4 and 6, this volume).

Our excavations at Vésztő-Bikeri and Körösladány-Bikeri were the first systematic, extensive, multidisciplinary investigations at Tiszapolgár settlements on the Great Hungarian Plain. Our ultimate goal was to learn about Early Copper Age community organization, subsistence practices, economic activities, interaction, and ritual behavior that would contribute to our broader understanding of the social and economic changes that occurred during the Neolithic–Copper Age transition. In this chapter, we discuss the archaeological techniques employed over the course of our excavations at the Bikeri sites and present the basic results. We provide detailed interpretations about the spatial and temporal development of the settlements in the following chapter (see Chapter 8, this volume).

Excavation Techniques and Documentation Methods

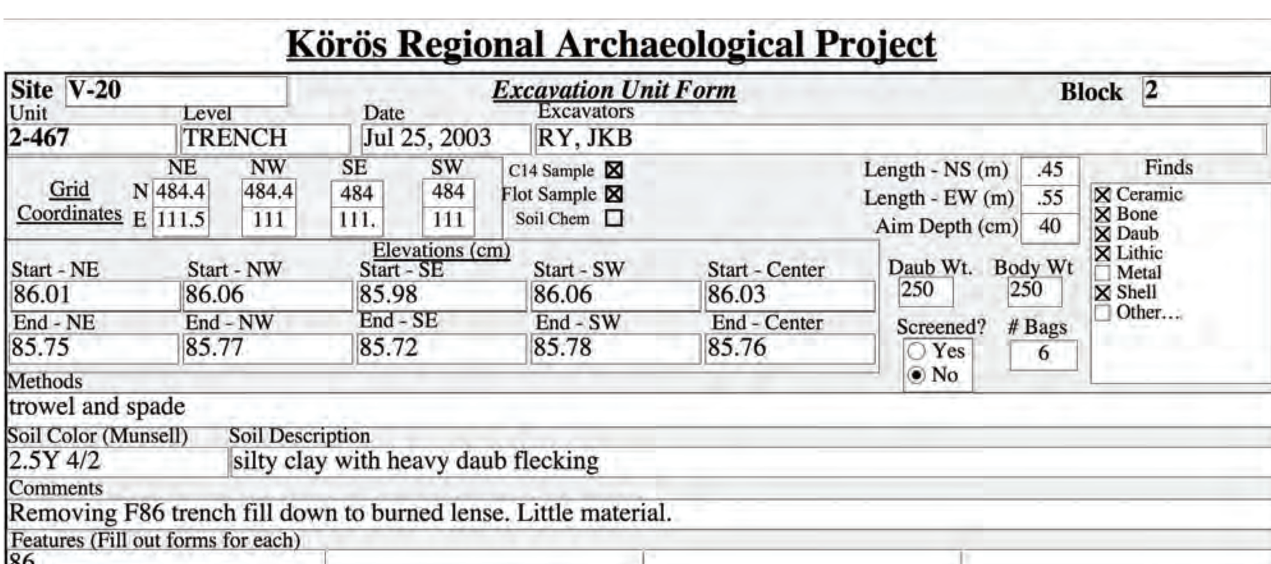
Initially, test excavation units were opened at both Bikeri sites based upon the information we collected during intensive surface collections, geophysical surveys, and geochemical studies (see Chapters 4 to 6, this volume). Subsequently, we conducted larger excavations that expanded upon the results of the test excavations. Six-week field seasons occurred during June, July, and August from 2000 to 2003 and in 2005 and 2006. Formal study seasons were carried out in 2004 and 2007, and additional specialist analyses were performed in subsequent years.

Our excavation methods at Vésztő-Bikeri and Körösladány-Bikeri combined micro-stratigraphic and alternating block grid techniques, which provided detailed observations and documentation of spatial relations between features and cultural materials in fills, middens, and other contexts. With the micro-stratigraphic technique, features, cultural layers, and construction, destruction, floor, and walking levels were excavated, while alternating block grids were used to produce cross-sections at close intervals. These cross-sections then were used to guide later excavations that followed natural stratigraphy.

Individual excavation units (EUs) were designated by excavation block number followed by an individual unit number (for example, EU 1-10, EU 4-22; Figure 7.1); this numbering system reflects the sequential order of how units were opened within each excavation block. Feature numbers were assigned sequentially as features were identified at each site (Figure 7.2). Because some features, such as ditches and palisades, extended into multiple excavation blocks, feature numbers were not separated by excavation block. Starting and ending elevations for each EU and features were recorded in meters above sea level with a total station. The northings and eastings used during the excavation were recorded using the Pulkovo 1942 projected coordinate system.

The upper part of the plowzone in the excavation blocks, typically 25–35 cm in depth, was removed by spades (in smaller test trenches) or by machinery (in larger excavation blocks) in units of various sizes, depending on the extent of the excavated surface. The base of the plowzone was exposed by hand tools to identify the top of the intact cultural layer, which always extended up into the plowzone. Because units in the plowzone were disturbed, the excavated sediments from those units were not sifted and flotation samples were not taken, but artifacts were collected by hand.

Whenever possible, excavation below the plowzone followed natural stratigraphy. When features were encountered, the EU was leveled off at the elevation where the top of the feature was first observed. In situ finds were plotted, photos were taken, and a plan map was drawn at that elevation. When possible, individual fill layers of features were removed as separate EUs. When natural layers could not be identified within features, the fill usually was excavated in arbitrary 10 cm levels. When possible, we sectioned features and excavated each half separately. After the stratigraphy was defined, photographs were taken, and a profile map was drawn, the remaining half of the feature was excavated by natural stratigraphic layers, with a separate EU number given to each layer of the feature fill. In ditches and wall trenches of buildings, separate EUs for each 1 m-long segment were assigned.


Körös Regional Archaeological Project

Site V-20 | *Excavation Unit Form* | Block 2

Unit 2-467 | Level TRENCH | Date Jul 25, 2003 | Excavators RY, JKB

Grid Coordinates	NE	NW	SE	SW
N	484.4	484.4	484	484
E	111.5	111	111.	111

C14 Sample ☒ Flot Sample ☒ Soil Chem ☐

Length - NS (m) .45
Length - EW (m) .55
Aim Depth (cm) 40

Elevations (cm)

Start - NE	Start - NW	Start - SE	Start - SW	Start - Center
86.01	86.06	85.98	86.06	86.03
End - NE	End - NW	End - SE	End - SW	End - Center
85.75	85.77	85.72	85.78	85.76

Daub Wt. 250 Body Wt 250
Screened? ○ Yes ◉ No
Bags 6

Finds: ☒ Ceramic ☒ Bone ☒ Daub ☒ Lithic ☐ Metal ☒ Shell ☐ Other…

Methods: trowel and spade

Soil Color (Munsell): 2.5Y 4/2

Soil Description: silty clay with heavy daub flecking

Comments: Removing F86 trench fill down to burned lense. Little material.

Features (Fill out forms for each): 86

Figure 7.1. The excavation unit form used by the Körös Regional Archaeological Project during excavations at Vésztő-Bikeri and Körösladány-Bikeri. *Figure by William A. Parkinson.*

Körös Regional Archaeological Project

Feature Form

Site K-14 **Block** 4 **Feature Number** 41 **ID** *K-14-4-F41*

Identified in EU	Ending in Unit	Date	Excavators
4-141	4-145	Jul 11, 2006	GB

Description of Feature

Shallow posthole identified at the bottom of paleosol extending into the subsoil.

Methods

Trowel

Soil Color (Munsell)	Soil Description
10 YR 4/1	Dark grey

Finds

☐ Ceramic ☐ Bone ☐ Daub ☐ Lithic ☐ Grnd Stone ☐ Metal ☐ Shell ☐ Other…

Number of Bags

0

Fill Volume (L)

Feature Drawings

4-031
4-041
4-023

Samples

☒ Flotation ☐ Radiocarbon ☐ Other…

Soil Samples	Radiocarbon Samples	Other Samples
4-145		
4-141		

Comments

No finds.

Interpretation of Feature

Posthole.

Feature coordinates: 438.57/998.47; 438.73/995.63; 438.57/999.64; 438.74/999.65

☐ Rodent Hole ☐ Bone Feature ☐ Burial
☒ Post Hole ☐ Pit ☐ Other…
☐ Ceramic Feature ☐ Floor

Include all drawings, and remember to indicate location of feature on all EU drawings!

Figure 7.2. The feature form used by the Körös Regional Archaeological Project during excavations at Vésztő-Bikeri and Körösladány-Bikeri. *Figure by William A. Parkinson.*

When features were not identified, the cultural deposit was excavated in 1 x 1 m, or occasionally 2 x 2 m, squares. If no change in natural stratigraphy was detected, a depth of 10–15 cm was removed within the squares at one time and recorded as a separate EU. Alternate quadrants also were used; this provided cumulative profiles in each square that were used to guide the excavations in adjacent squares. The number and weight of artifacts, faunal remains, and other objects were recorded by EU in the field (Figure 7.1). This permitted us to produce density maps with a high degree of spatial resolution. With few exceptions, sediments excavated below the plowzone were sifted through dry sieves with 6 mm (¼-inch) galvanized hardware cloth mesh, and flotation samples of at least 10 l were taken from every EU to recover small artifacts and small floral and faunal remains. When possible, feature fills were floated in their entirety.

When human burials were encountered, the limits of the burial pit were defined and the skeleton and associated grave goods were exposed. The burial was photographed and mapped, and grave goods were piece-plotted before they were removed.

Paper EU forms were used to record data in the field (Figure 7.1). Information on the forms was entered into the excavation database in the lab at Vésztő. The site, block, and EU numbers were listed on each EU form, along with the stratigraphic context, date, and the initials of the excavators. The grid coordinates that defined each EU also were entered, along with the dimension of the EU, the target depth, and the starting and ending elevations for each corner as well as the center point of the EU. The method of excavation (such as backhoe, spades, or trowels) also was recorded. It was noted whether the excavated sediment was sifted or not. Sediments were described, and Munsell color designations also were provided in the EU forms. The presence of different types of cultural materials (for example, ceramic, daub, lithic, metal) and faunal and floral remains was noted for each EU.

The EU form also was used to record the field weight of the recovered daub and ceramics. These artifacts were weighed with spring scales in the field. All ceramic sherds were collected, but only a representative sample of daub (usually several pieces, particularly ones with wattle or other organic impressions) from each EU was kept for further analysis. The different types of finds were placed in separate paper or plastic bags. Separate bags were used for in situ clusters of cultural materials. When excavation of a unit was complete, the total number of bags collected was entered on the EU form.

The kinds of samples (flotation, radiocarbon, and soil chemistry) taken from each unit were noted. There also was room on the form for excavator's comments, information about photographs and drawings as well as features associated with the particular EU.

Separate field forms were used to record information about features exposed in the blocks (Figure 7.2). Each settlement and burial feature, as well as artifact concentration, was provided with a separate feature number. Feature forms listed the site, block, and feature number, the EU numbers where the feature was identified and ended, the date when the feature was discovered, and the initials of the excavators. The excavation methods, sediment descriptions, finds, samples, photographs, maps, and drawings also were entered on the feature form. There was room for a description of the feature, including its grid coordinates and starting and ending elevations. The interpretation of the feature was written on the form, and the plans, profile drawings, and maps of the feature were attached to the feature form. This information also was entered into the feature log for each site and into the project database (see Appendixes IV to VI, this volume).

When the bags from the EUs and features were checked in at the field lab in Vésztő, the counts and weights of the various artifact types were recorded for each EU on washing forms (Figure 7.3). Ceramics and lithic artifacts were washed with water. Metal, bone, and shell items were cleaned with dry brushes and wooden picks. Cultural materials were labeled before the initial identification, classification, and analyses were completed.

Additional databases and spreadsheets were used for the specialized analyses of the various types of finds. FileMaker Pro software was utilized to create and manage the main databases for the project.

Excavations at Vésztő-Bikeri

In the summer of 2000, we initiated test excavations to assess the preservation and integrity of subsurface remains at Vésztő-Bikeri. Based upon the results of our surface collections in 1998 (see Chapter 4, this volume), we sought to determine whether there were cultural layers intact beneath the plowzone. Guided by those test excavations, as well as a subsequent geophysical survey (see Chapter 6, this volume), we expanded some of the test units and opened several larger excavation blocks at Vésztő-Bikeri between 2001 and 2003 (Figure 7.4). Information about individual exposed features at Vésztő-Bikeri, including type, location, dimensions, and materials excavated, is presented in Appendixes IV and V.

CREATE NEW RECORD

Körös Regional Archaeological Project - Washing Form

Site	Unit	Date	Who	Ceramic #	Ceramic Wt	Bone #	Bone Wt	Shell #	Shell Wt	Lithic #	Lithic Wt	Gr St #	Gr St Wt	Oth #	Oth Wt	Oth Desc	Daub?	C14?	Soil?	Comments
V-20	1-001	Jul 4, 2000	RY	420	5000	41	84	0	0	1		0	0	4		Glass Fragment	Y	N	N	
V-20	1-002	Jul 6, 2000	WP	144	700	57	072	2	1	0	0	0	0	0			Y	N	N	daub sample
V-20	1-003	Jul 6, 2000	RY	7	32	6	2.2	2	0.2	0	0	0	0	2	0.9	Mineral	1	1	0	radiocarbon sample
V-20	1-004	Jul 10, 2000	RY	7	43	6	3.8	1	.05	1		0	0	12	37.1	daub	Y	Y	N	7 body sherds, i charcoal sample, 1
V-20	1-005	Jul 10, 2000	RY			1	2.9	1	7.8	0	0	0	0	0	0		N	N	N	
V-20	1-006	Jul 10, 2000	RY	2	1.6	1	0.4	3	0.5	0	0	0	0	1	0	charcoal	Y	Y	N	2 body sherds
V-20	1-007	Jul 10, 2000	RY	2	9.3	1	1.4	1	0.5	0	0	0	0	1	13.9	charcoal	Y	Y	N	2 body sherds
V-20	1-008	Jul 10, 2000	RY	1	2.4	1	0.1	0	0	0	0	0	0	1	10.8	charcoal	N	Y	N	1body sherds
V-20	1-009	Jul 10, 2000	RY			0	0	0	0	0	0	0	0	0	0		1	0	0	daub sample 75g
V-20	1-010	Jul 10, 2000	RY			1	1.9	2	5.4	0	0	0	0	0	0		Y	N	N	
V-20	1-011	Jul 10, 2000	RY			2	0.3	0	0	0	0	0	0	0	0		N	N	N	
V-20	1-012	Jul 11, 2000	RY	8	18.41	2	3.4	0	0	0	0	0	0	0	1	charcoal	Y	Y	N	radiocarbon sample, soil sample
V-20	1-013	Jul 13, 2000	RY	1	1	2	2.1	0	0	0	0	0	0	0	0		1	1	1	
V-20	1-014	Jul 13, 2000	RY	11	104	0	0	0		0	0	0	0	0	0		1	0	0	daub sample, wall cleaning
V-20	1-015	Jul 14, 2000	RY			0	0	0	0	0	0	0	0	0	0		0	0	1	soil sample, feature 1, ph 3
V-20	1-016	Jul 14, 2000	RY			0	0	0	0	0	0	0	0	0	0		0	0	1	soil sample, feature 1, ph 4
V-20	1-017	Jul 14, 2000	RY	16	106	0	0	2	4.5	0	0	0	0	0	0		1	0	0	daub - 500 g
V-20	1-018	Jul 14, 2000	RY	11	92	2	8.5	0	0	0	0	0	0	0	0		1	0	0	daub - 235 g
V-20	1-019	Jul 14, 2000	RY	9	15	5	10	0	0	0	0	0	0	0	0		1	0	0	daub: 300 g, se quad E wall cleaning
V-20	2-001	Jul 10, 2000	WP	168	511	0	0	0	0	0	0	0	0	1		Iron Fragment	Y	N	N	
V-20	2-002	Jul 11, 2000	WP	221	1375	13	16.5	0	0	2		0	0	2	0	lithic	Y	N	N	
V-20	2-003	Jul 11, 2000	WP	48	250	0	0	0	0	0	0	0	0	0	0		N	N	N	
V-20	2-004	Jul 11, 2000	WP	10	99	0	0	0	0	0	0	0	0	0	0		N	N	N	
V-20	2-005	Jul 11, 2000	WP	73	750	53	111	0	0	0	0	1		4	260.8	Mica/Stone	N	N	N	
V-20	2-006	Jul 11, 2000	WP	18	166	0	0	0	0	0	0	0	0	1	12	Stone	Y	N	N	
V-20	2-007	Jul 11, 2000	WP	28	179	24	32	0	0	0	0	0	0	0	0		Y	N	N	
V-20	2-008	Jul 11, 2000	WP	3	14.6	18	150	0	0	0	0	0	0	0	0		N	N	N	cleaning pedestal sheds
V-20	2-009	Jul 17, 2000	CR	22	143.9	4	19.4	0	0	0	0	0	0	0	0		1	0	0	daub: 52.2
V-20	2-010	Jul 14, 2000	CR	21	261	5	8.4	0	0	0	0	0	0	0	0		1	0	0	daub 73.7 g
V-20	2-011	Jul 14, 2000	CR	3	30.9	1	29.3	1	0.9	0	0	0	0	0	0		0	0	0	
V-20	2-012	Aug 2, 2000	WP			0	0	0	0	0	0	0	0	0	0		0	0	0	
V-20	2-013	Jul 15, 2000	CR	36	274	33	17.8	0	0	0	0	0	0	60	118	daub w/ impression, bone	3	0	0	daub:2300 g, south wall, south 1/4
V-20	2-014	Jul 22, 2000	CR	44	470	65	43	0	0	1	3	0	0	1	2	arrowhead	1	2	n	daub sample 600 g
V-20	2-015	Jul 22, 2000	CR	11	200	3	5	0	0	0	0	0	0	0	0		Y	0	0	daub sample 62 g/ 2-15/ f-6
V-20	2-016	Jul 22, 2000	CR	32	724	3	15	0	0	0	0	0	0	0	0		1	0	0	daub: 600 g, 2-16 F-6
V-20	2-017	Aug 2, 2000	WP			0	0	0	0	0	0	0	0	0	0		0	0	0	?maybe missing lot? cannot find any
V-20	2-018	Jul 26, 2000	WP	77	904	75	350	0	0	0	0	0	0	0	0		Y	1	N	
V-20	2-019	Jul 22, 2000	CR	9	32	3	5	3	6	0	0	0	0	0	0		1	0	0	daub: 500, profile cleaning,
V-20	2-020	Jul 24, 2000	Anett			4	0.8	0	0	0	0	0	0	0	0		1	0	0	daub: 247.3
V-20	2-021	Jul 26, 2000	WP	53	464	21	9	0	0	0	0	0	0	7	35	Slag	Y	N	N	daub: 800 g

Figure 7.3. The washing form used by the Körös Regional Archaeological Project during excavations at Vésztő-Bikeri and Körösladány-Bikeri. *Figure by William A. Parkinson.*

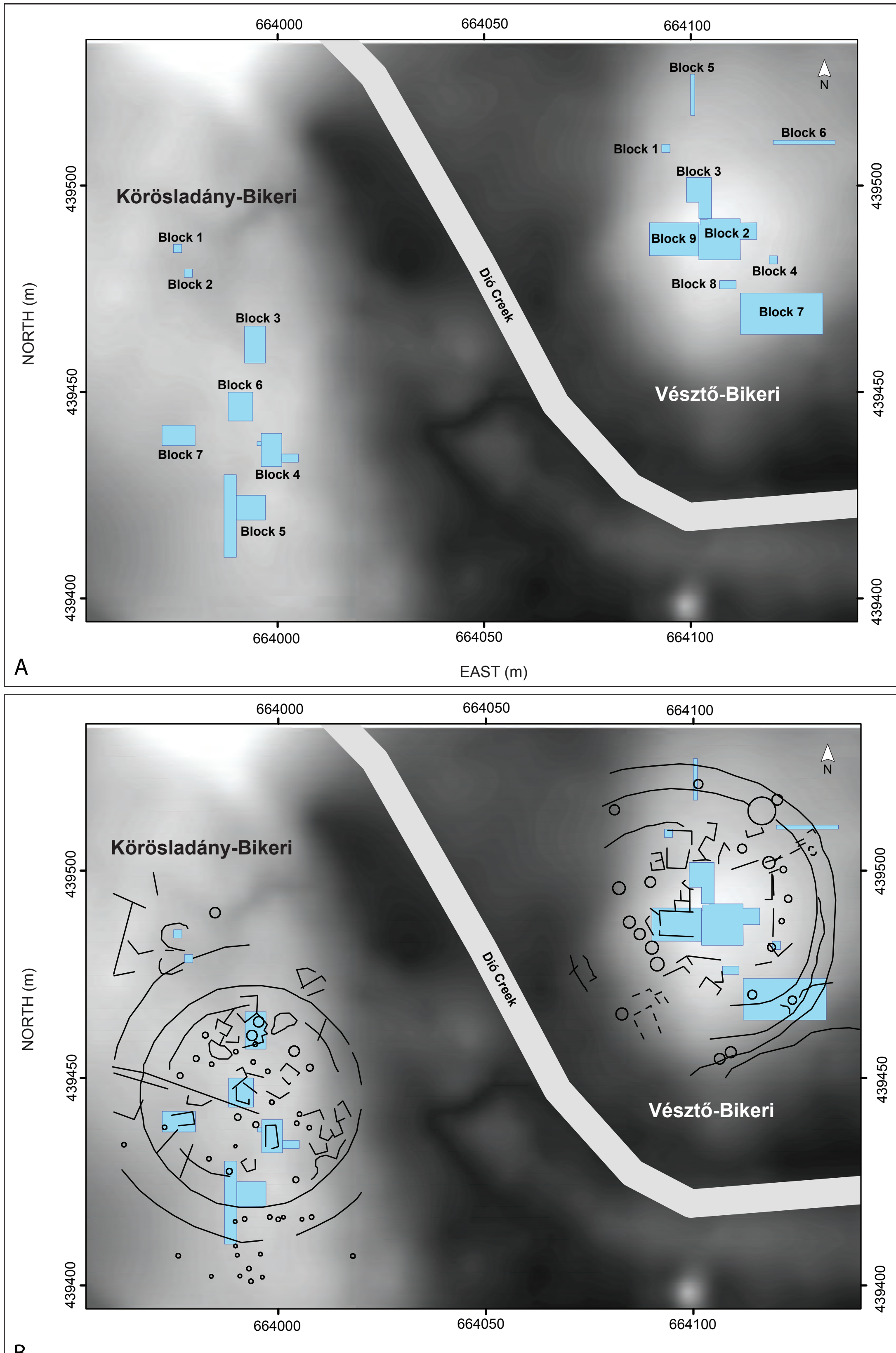


Figure 7.4. A: Topographic map of Vésztő-Bikeri and Körösladány-Bikeri showing the locations of excavation blocks. Lighter colors indicate higher elevations. B: Topographic map of Vésztő-Bikeri and Körösladány-Bikeri showing the locations of excavation blocks and magnetic anomalies. *Figure by William A. Parkinson.*

Test Excavations at Vésztő-Bikeri

In the summer of 2000, four 2 x 2 m test units were laid out at Vésztő-Bikeri. Three test units (Blocks 1, 2, and 3) were placed where burned daub concentrations had been identified on the surface, suggesting that structures may be found below; two of these concentrations were documented during surface collections in 1998 (Surface Features 3 and 4; see Chapter 4, this volume). Block 4 was placed where there was a high concentration of animal bones and ceramics on the surface in the southeastern section of the site. It was thought that this marked the location of part of a ring midden around the center of the settlement.

In the test units, the plowzone was removed by spades to depths of 25–35 cm, exposing substantial quantities of artifacts and faunal material in each block. Each 2 x 2 m test unit was subdivided into four 1 x 1 m quadrants to excavate the cultural layers and features beneath the plowzone.

In Block 1 (Figure 7.4), a floor level that seemed to have been truncated by plowing was identified below smaller clusters of burned daub. A north–south oriented wall trench with four postholes was visible at the base of the plowzone in the northeast and southeast quadrants (Feature 1; Figure 7.5). In the southwest quadrant, a small, circular pit or large posthole was found under the floor (Feature 2; Figure 7.5). Along the northern wall of the block, the edge of a pit or posthole was exposed (Feature 3; Figures 7.5–7.6). The edge of another pit was visible farther east in the north profile (Feature 7). Geophysical prospection at the site in 2002 revealed that the northwestern corner of a rectangular building (anomaly A1; see Chapter 6 and Figure 6.3, this volume) had been exposed in the Block 1 test trench.

In Blocks 2 and 3 (Figure 7.4), the upper cultural layer just below the plowzone contained substantial amounts of burned daub, charcoal, burned Tiszapolgár ceramics, and burned antler and bone fragments. This layer was disturbed by deep plowing in this central part of the Vésztő-Bikeri site, but in some places, an underlying burned daub layer protected the cultural layers beneath. Immediately below the daub layer in Blocks 2 and 3, there were more compact floor levels with flat-lying ceramics and small flecks of daub. Some charcoal as well as bone and lithic artifacts had also been incorporated into these floor levels.

In Block 2, a roughly 5–15 cm thick daub layer covered the floor level, and it appeared that this layer was located in the corner of a burned Early Copper Age structure (Feature 4; Figures 7.7–7.8). Several dozen complete and fragmentary, burned, tanged, and hollow-base arrowheads made of antler, as well as their manufacturing debitage, were found in this daub layer and on the floor (see Chapter 11 and Figures 11.7–11.9, this volume).

In Block 3, the daub layer was less extensive, but it seemed to cover the floor of another burned structure (Feature 5; Figures 7.9–7.10). A dense concentration of Early Copper Age ceramics was found above and on the poorly preserved floor level.

In Block 4 (Figure 7.4), a midden truncated by plowing was encountered immediately below the plowzone (Figure 7.11). No daub layer, floor levels, or other distinct features were identified in this area, but the excavation of 70 cm of plowzone and cultural deposit in this 4 m² produced more than 25 kg of Early Copper Age ceramics and a massive quantity of animal bones.

The 2000 test excavations at Vésztő-Bikeri demonstrated that although plowing had disturbed the site to some extent, intact Early Copper Age cultural layers and in situ features remained below the plowzone. A sequence of cultural deposits about 40–65 cm thick, including a midden, daub layers, floor levels, and cultural layers, was exposed in the 2 x 2 m test excavation units, and exclusively Early Copper Age materials were found. This considerable stratigraphy contradicted the common view of ephemeral Early Copper Age settlements on the Great Hungarian Plain (see Chapters 1 and 8, this volume) and indicated the intensive, continuous habitation of the site for a longer period of time. The test excavations also confirmed that further investigations had a great potential to critically contribute to understanding the layout, use, and duration of Tiszapolgár settlements.

Large-Scale Excavations at Vésztő-Bikeri

Based on the results of the 1998 surface collection, the 2000 test excavations, and additional geophysical and geochemical surveys (see Chapters 4 to 6, this volume), we expanded Blocks 2 and 3 in 2001–2003. Blocks 5 and 6 were excavated in 2002, and Blocks 7, 8, and 9 were excavated in 2003 (Figure 7.4). In addition to the overwhelming predominance of Early Copper Age artifacts, a very few Early Neolithic (Körös culture; circa 6000–5500 cal BC), Late Bronze Age (Gáva culture; circa 1300–900 cal BC), Árpádian Age (eleventh to thirteenth century AD), and medieval (fourteenth to seventeenth century AD) ceramics were found at the site (see Chapter 9, this volume), but features dating to these periods were not identified. The only features that postdated the Early Copper Age were two Hungarian Conquest period (ninth to tenth century AD) burials (see Chapter 16, this volume), as well as a recent, historic pig burial.

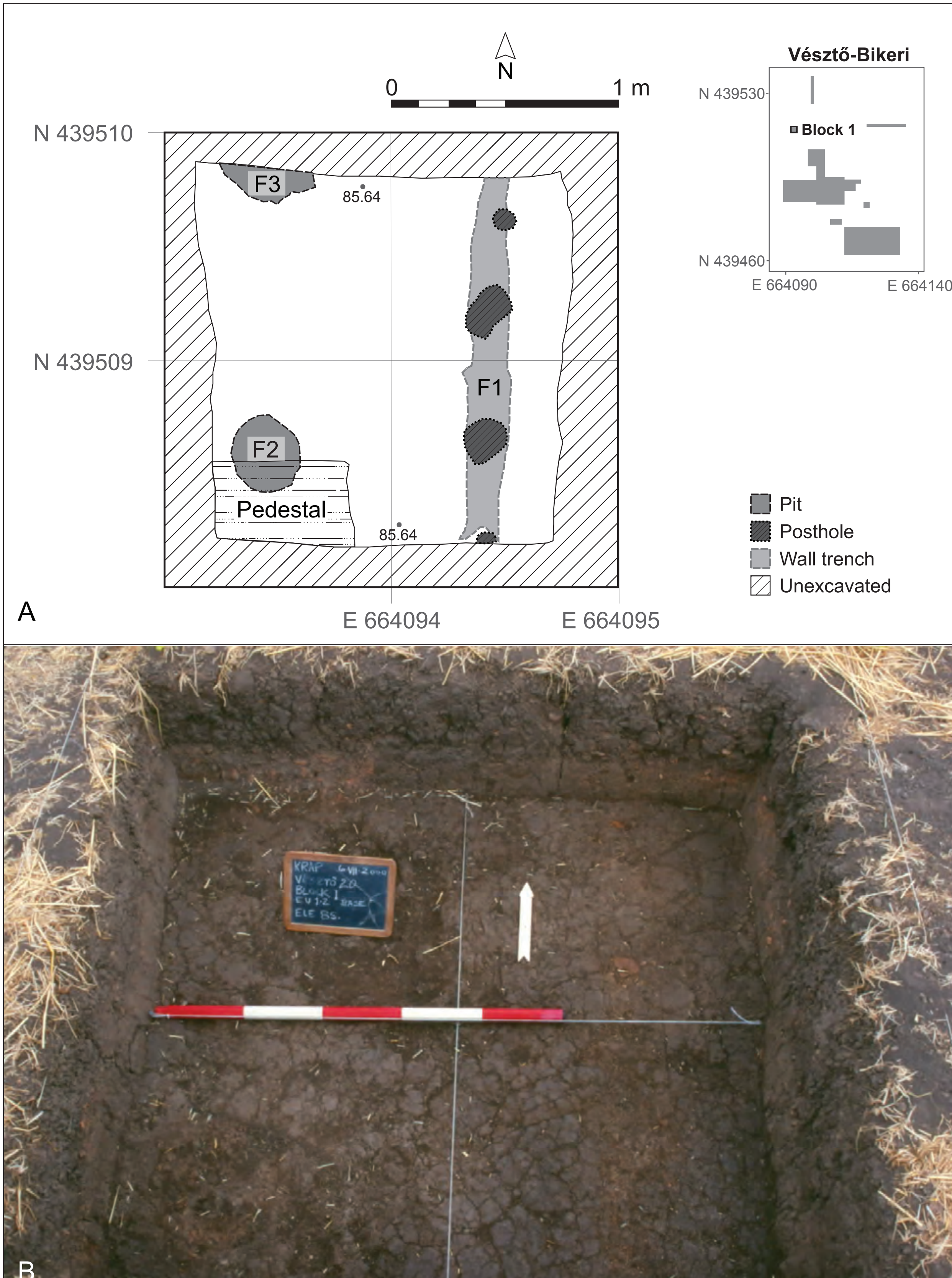


Figure 7.5. Block 1 test excavation trench at Vésztő-Bikeri. A: Plan map; B: Photograph. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

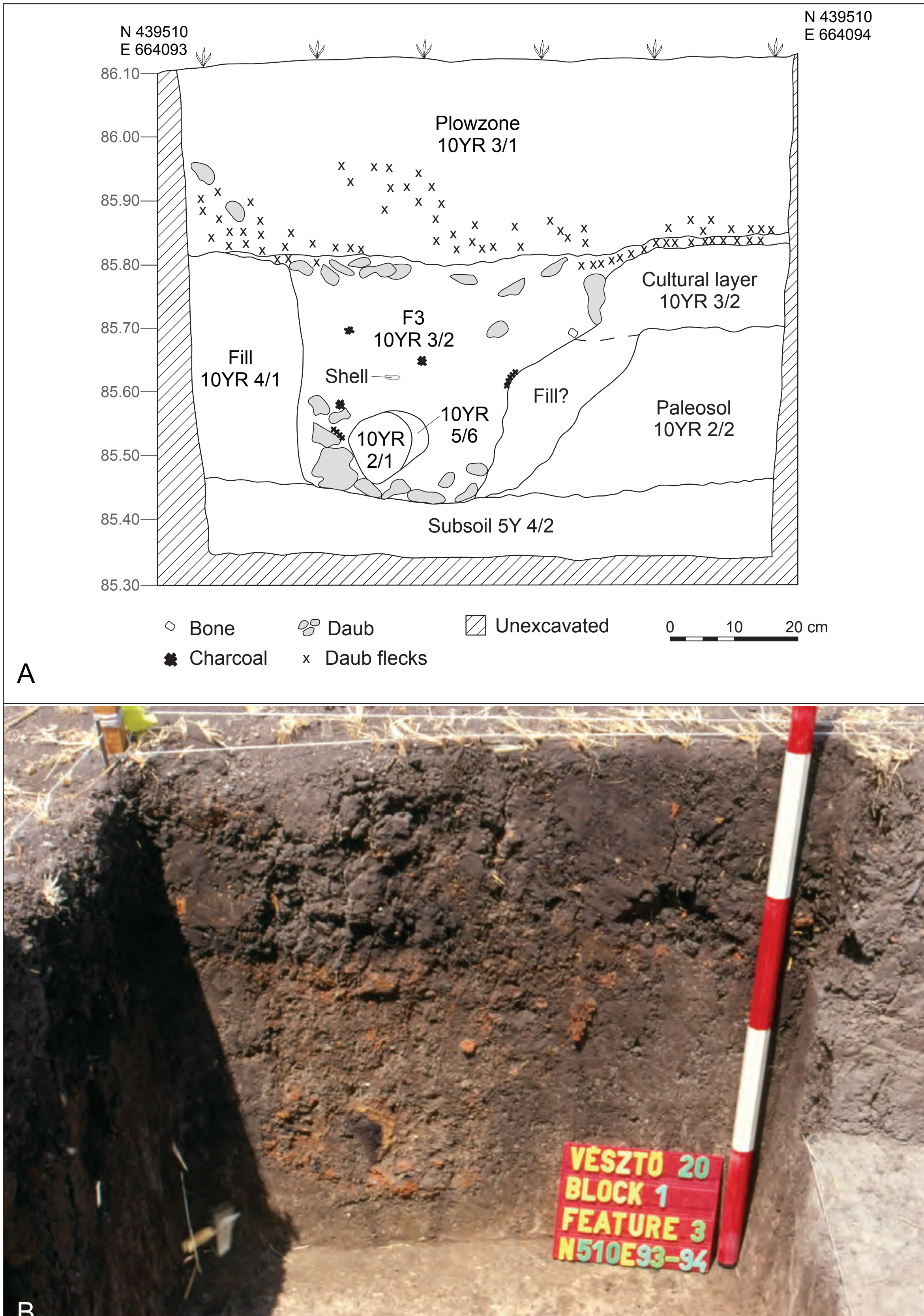


Figure 7.6. North profile of the northwestern quarter of Block 1 test excavation trench at Vésztő-Bikeri. A: Profile drawing; B: Photograph. Facing north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

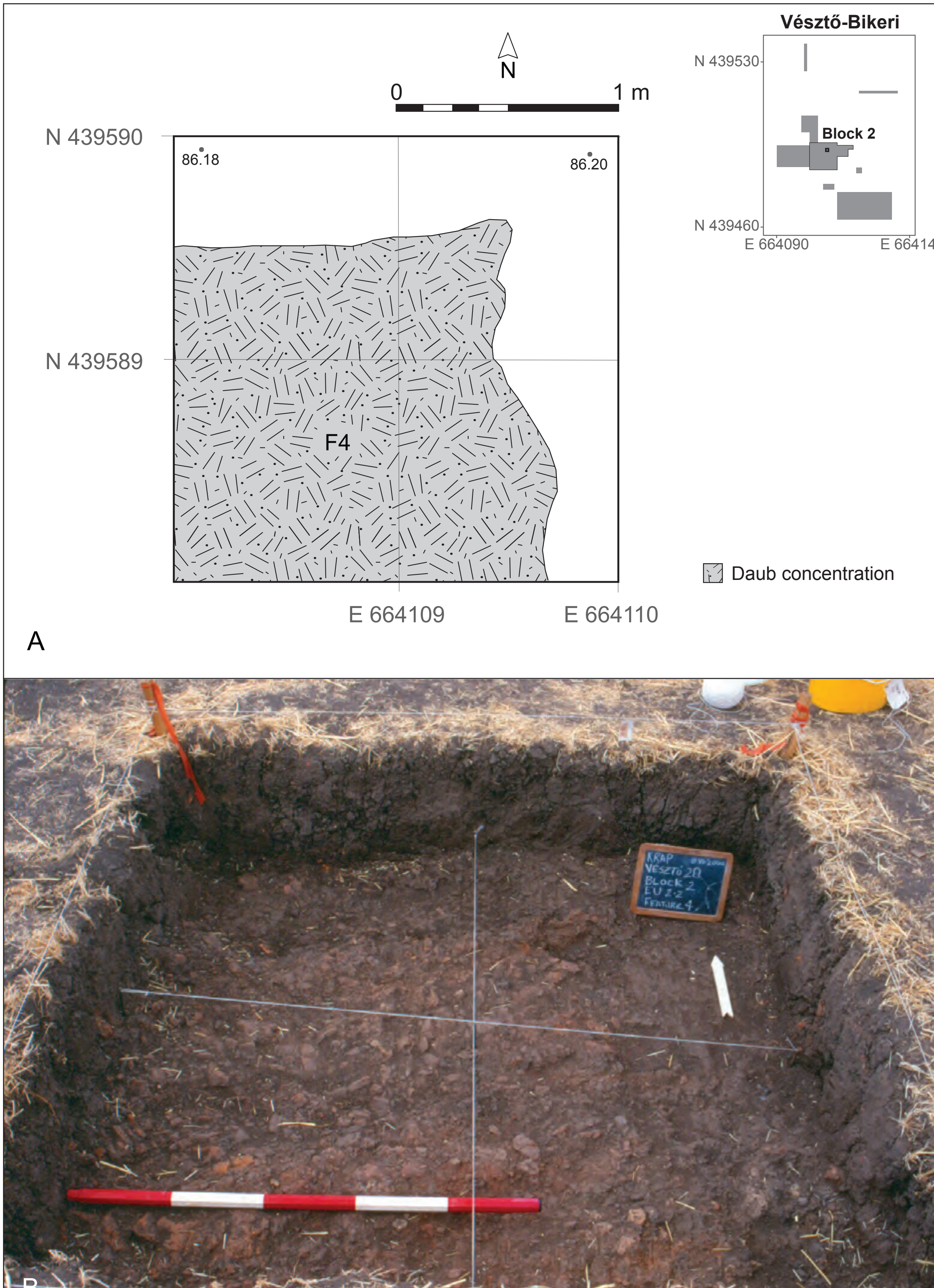


Figure 7.7. Block 2 test excavation trench with Feature 4 at Vésztő-Bikeri. A: Plan map; B: Photograph. Facing north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

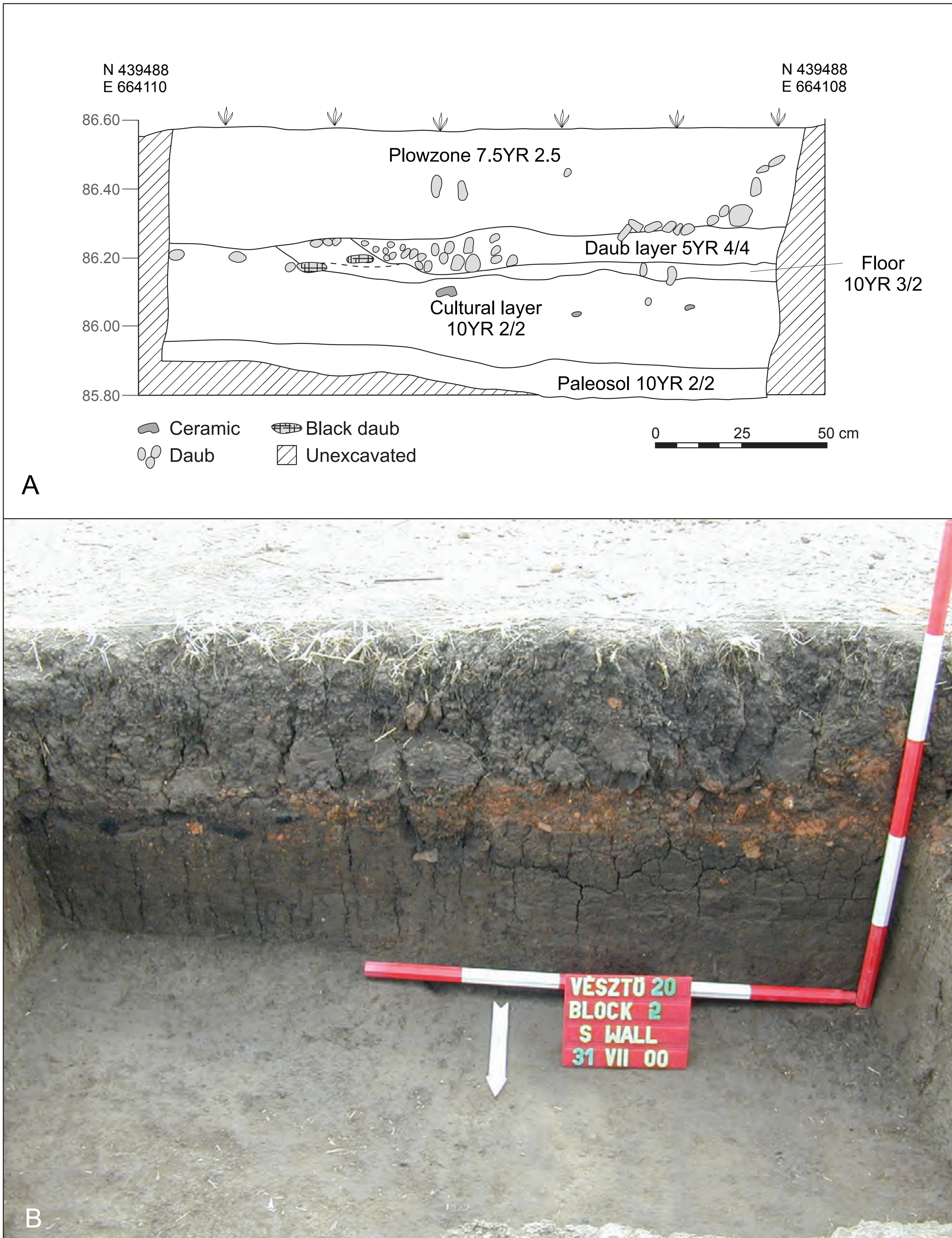


Figure 7.8. South profile of Block 2 test excavation trench at Vésztő-Bikeri. A: Profile drawing; B: Photograph. Facing south. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

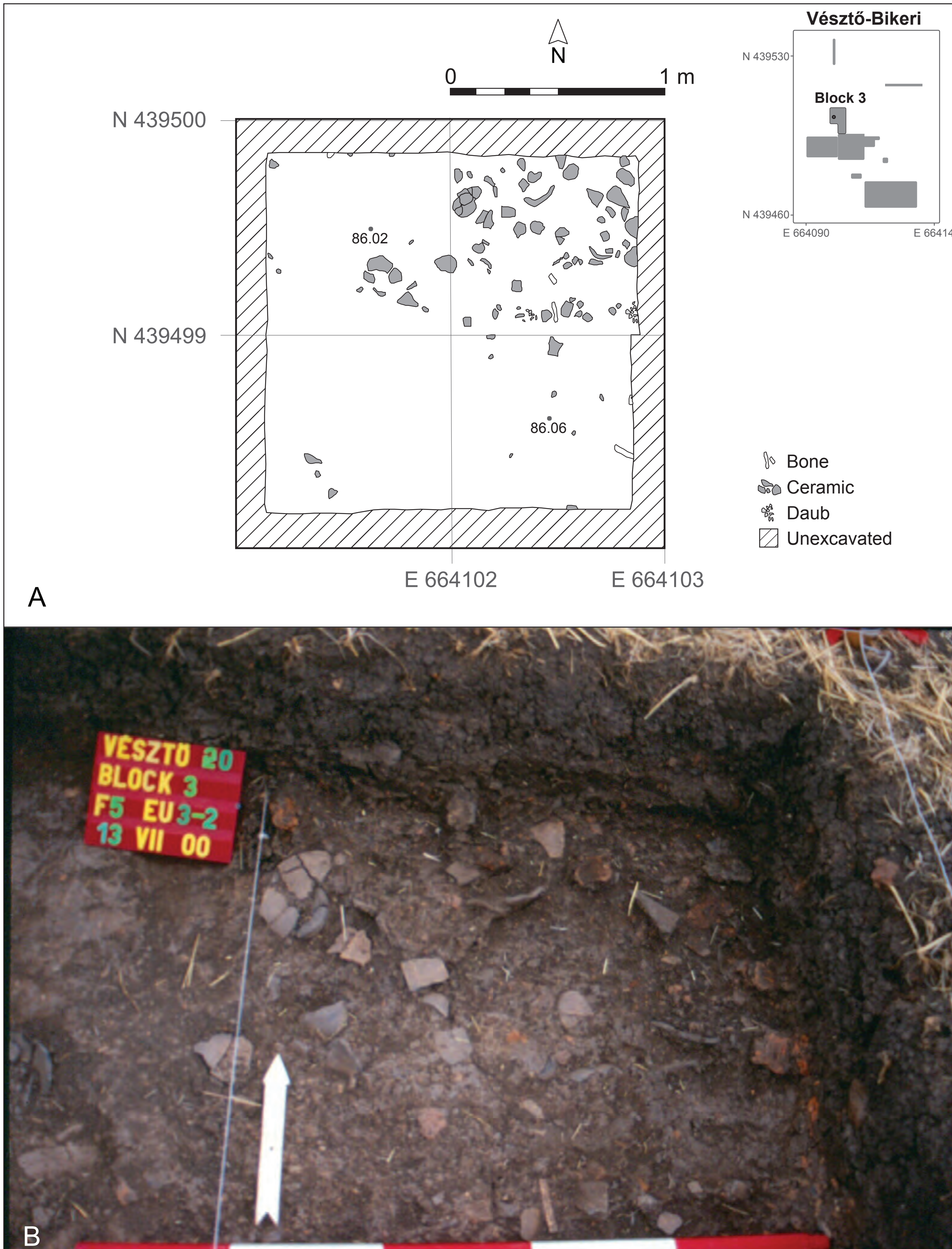


Figure 7.9. Block 3 test excavation trench at Vésztő-Bikeri. A: Plan map; B: Photograph of northeast quarter. Facing north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

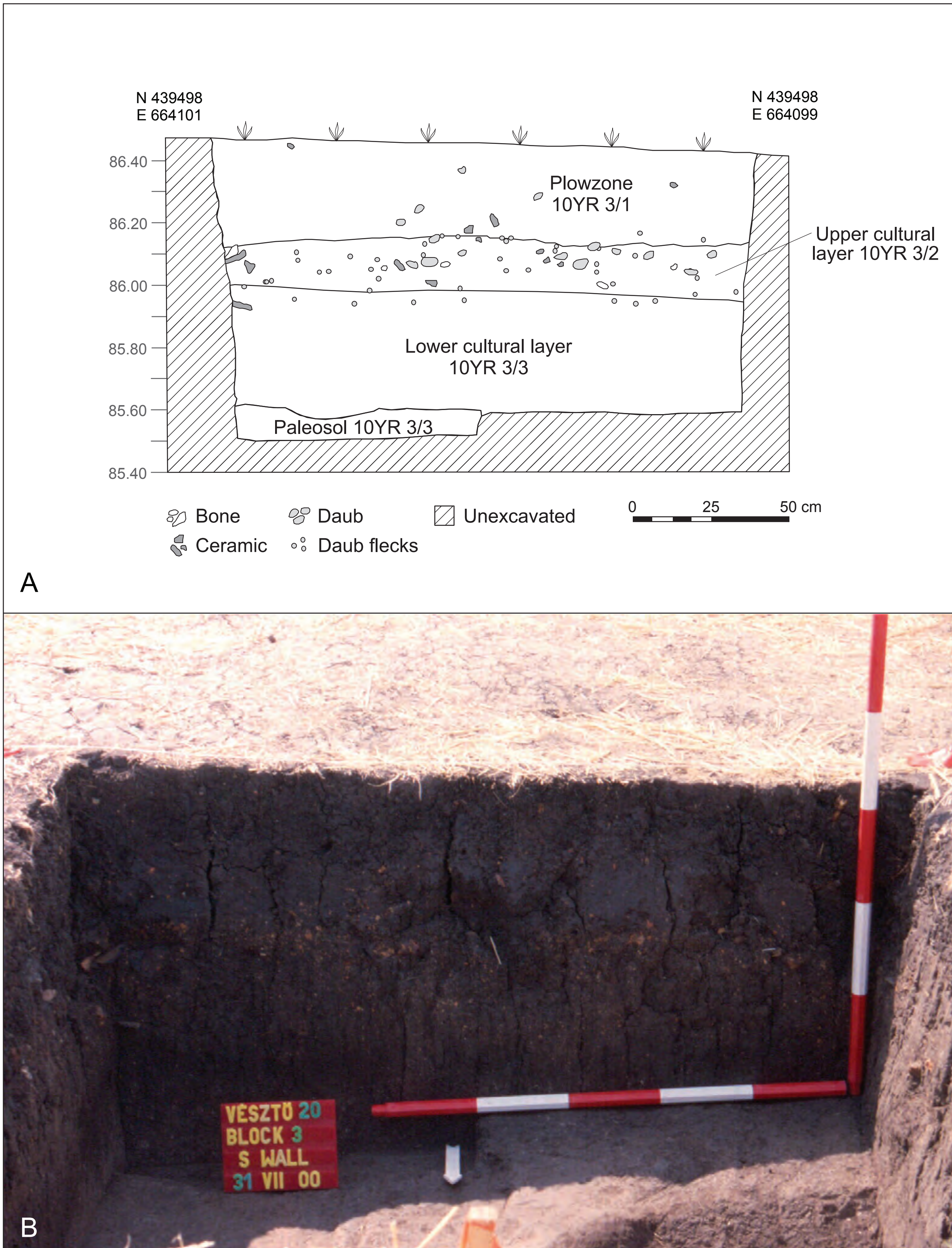


Figure 7.10. South profile of Block 3 test excavation trench at Vésztő-Bikeri. A: Profile drawing; B: Photograph. Facing south. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

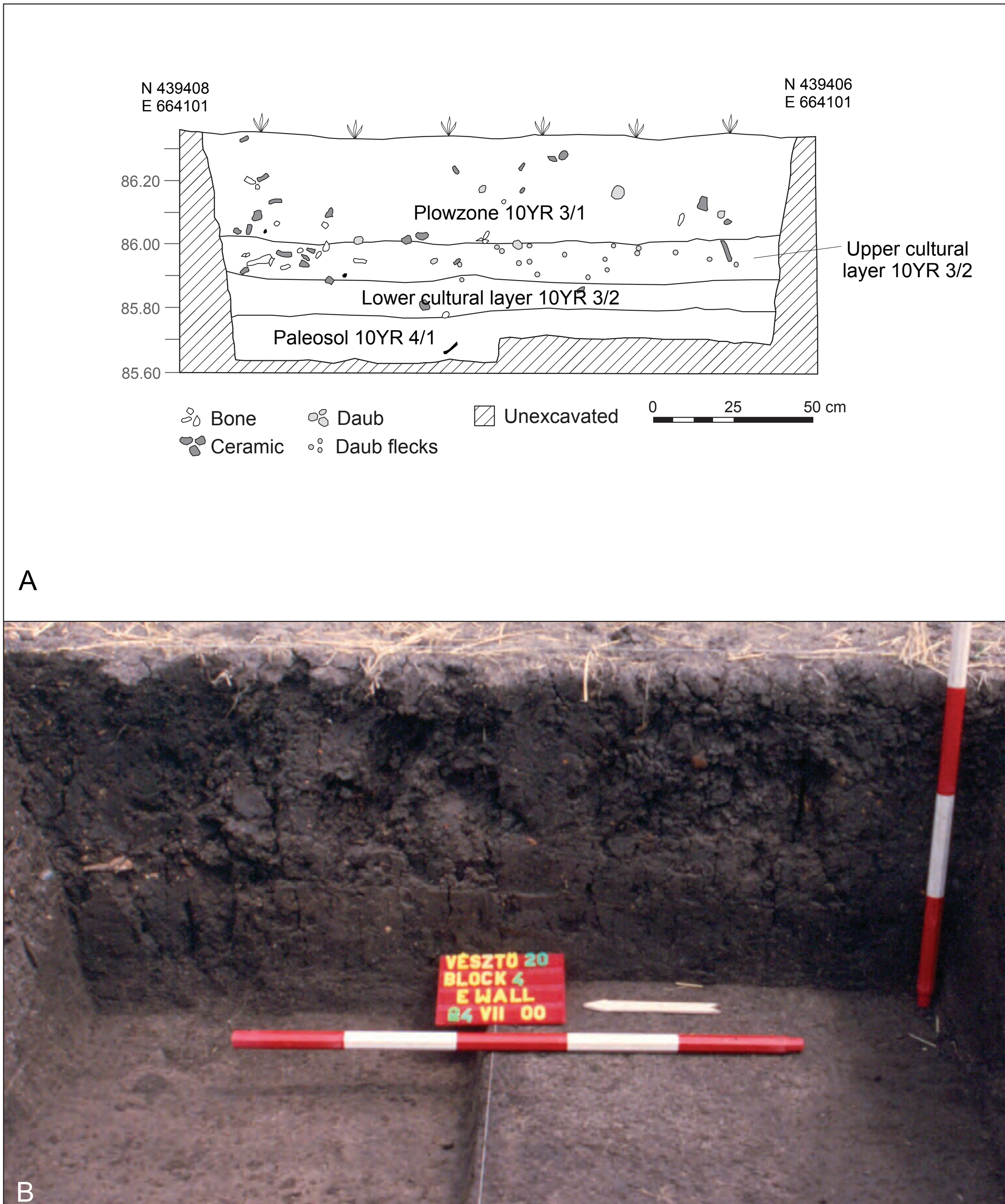


Figure 7.11. East profile of Block 4 test excavation trench at Vésztő-Bikeri. A: Profile drawing; B: Photograph. Facing east. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

Block 2

The Block 2 test unit at Vésztő-Bikeri was expanded to 10 x 10 m in 2001 to expose the structure that had been identified in 2000 (Feature 4; Figures 7.4 and 7.12). The upper part of the plowzone was removed with a small backhoe, and the top of the daub layer was exposed using hand tools. The daub layer did not cover the entire floor area of the structure; the 5–15 cm-thick, consistent, red or orange daub layer was restricted to an area of about 4 x 4 m, below which a thinner (about 1–3 cm), less burned, black daub layer was documented in some areas. Charcoal clusters, including large pieces indicating wooden planks or timbers, were found in or under this black daub layer. A cultural deposit with significant amounts of Early Copper Age material covered the daub rubble and, where the daub layer was not observed, the top of the floor. This cultural deposit extended into the plowzone.

During excavation, we identified a roughly 1–1.5 m break in the daub layer starting in the eastern end of the test unit (Figure 7.12). The daub layer located to the east of this break and its associated floor were designated Feature 14. To define the eastern extent of this feature, in 2002 a 4 x 4 m extension was added to Block 2 where the daub layer continued (Figure 7.13). Subsequent excavations established that Features 4 and 14 were parts of the same east–west oriented wattle-and-daub longhouse, and the structure was designated Feature 4/14 (Figure 7.12).

A floor deposit underlying the burned daub layer was recognized as lighter and more compact, and it was higher in the center, gradually tapering as it approached the limits of the structure. During the removal of the burned daub layer and the exposure of the floor, a nearly complete, vitrified Tiszapolgár vessel was found in the northwestern section of the house (Feature 10; Figures 7.12 and 7.14), a cluster of several cups was recovered from the central part, and crushed, large storage vessels were exposed in the eastern part of the floor. In some cases, these vessels were found upside down, indicating that they may have fallen from a higher place, possibly shelves. We did not find similar concentrations of vessels in the southern part of the building, where concentrations of Early Copper Age sherds, other artifacts, and animal bones on the floor also were documented, frequently under smaller clusters of daub.

Immediately south of the 2000 test unit, additional complete and broken antler and bone arrowheads as well as their manufacturing debris were found between daub chunks and on the floor level; a total of 233 arrowhead items were distributed in an area of 1 x 1.5 m (see Chapter 11, this volume). The arrowheads might have been manufactured in this part of Feature 4/14, and some may have been hanging on the northern wall of the building when it burned. Other small finds from the structure include a tiny fragment of gold sheet recovered from the sediment that covered Feature 4/14 and a small, perforated, fragmentary copper sheet found at the base of the plowzone (see Chapter 13, this volume).

In addition to the floor level, which was thin and difficult to follow during excavation, wall foundation trenches along the northern, western, and southern walls also confirmed the dimensions of Feature 4/14. The northern wall trench of the longhouse was about 12 m long (Feature 26; Figure 7.15). The stratigraphy at the northwest corner of the Feature 4/14 structure was very complex (Figure 7.16). In addition to a rodent disturbance, four features, representing several subsequent episodes of activity at the site, also were identified (Features 13, 23, 24, and 30).

Feature 30 was a deep posthole that belonged to the north wall of the Feature 4/14 structure, and it was located very close to the northwest corner of the building (Figure 7.16). Only the bottom of this posthole was identifiable, but it was dug into the base of the Feature 26 wall trench. Feature 30 was about 25 cm wide, but some of the fill in the base of the posthole might have been packed, and the actual post may have had a diameter of about 20 cm.

Feature 30 was truncated by a large bell-shaped pit (Feature 13; Figure 7.16). It seems that the northwest corner of Feature 4/14 and the northeast corner of the Feature 15 longhouse were destroyed when Feature 13 was created. The fill of Feature 13 contained a lot of burned daub, Early Copper Age ceramics, charcoal, and faunal remains.

Just to the east of these superimposed features, another posthole was excavated into the filled-in Feature 26 wall trench (Feature 24; Figure 7.16), presumably at about the same time Feature 13 was dug.

After Feature 13 was filled in, a smaller oval pit was dug into it (Feature 23; Figure 7.16). This pit had two fill layers, and it was located above the truncated Feature 30 posthole. After Feature 23 was filled in, all the superimposed features described above were covered with cultural material that was deposited over the abandoned longhouses in the center of the Vésztő-Bikeri site (see Chapter 8, this volume).

The eastern edge of the north wall trench of the Feature 15 longhouse also was visible in this cross-section (Feature 29; Figure 7.16). The eastern end of the Feature 15 structure extended into the western edge of Block 2. Our excavations established that the east wall of Feature 15 was reused as the west wall of Feature 4/14 (Feature 28; Figures 7.17 and 7.19).

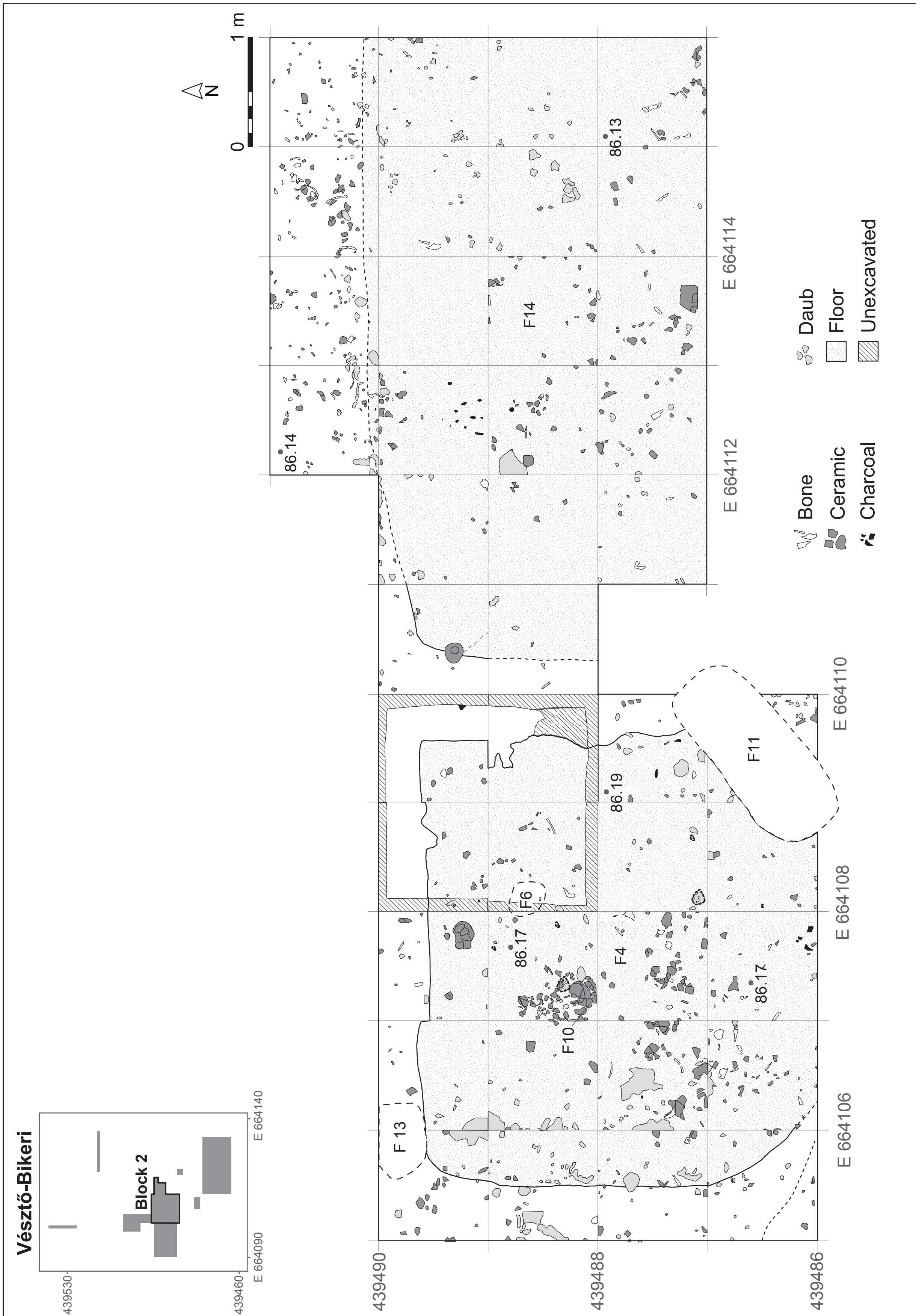


Figure 7.12. Plan map of Block 2 at Vésztő-Bikeri showing the floor surface of the Feature 4/14 longhouse. *Figure by Jill Seagard.*

Figure 7.13. Photograph of Block 2 at Vésztő-Bikeri showing the daub layer and floor surface of the F4/14 longhouse during excavation. Facing west. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Figure 7.14. Photograph of burned vessel (Feature 10) on floor of Feature 4/14 longhouse in Block 2 at Vésztő-Bikeri. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

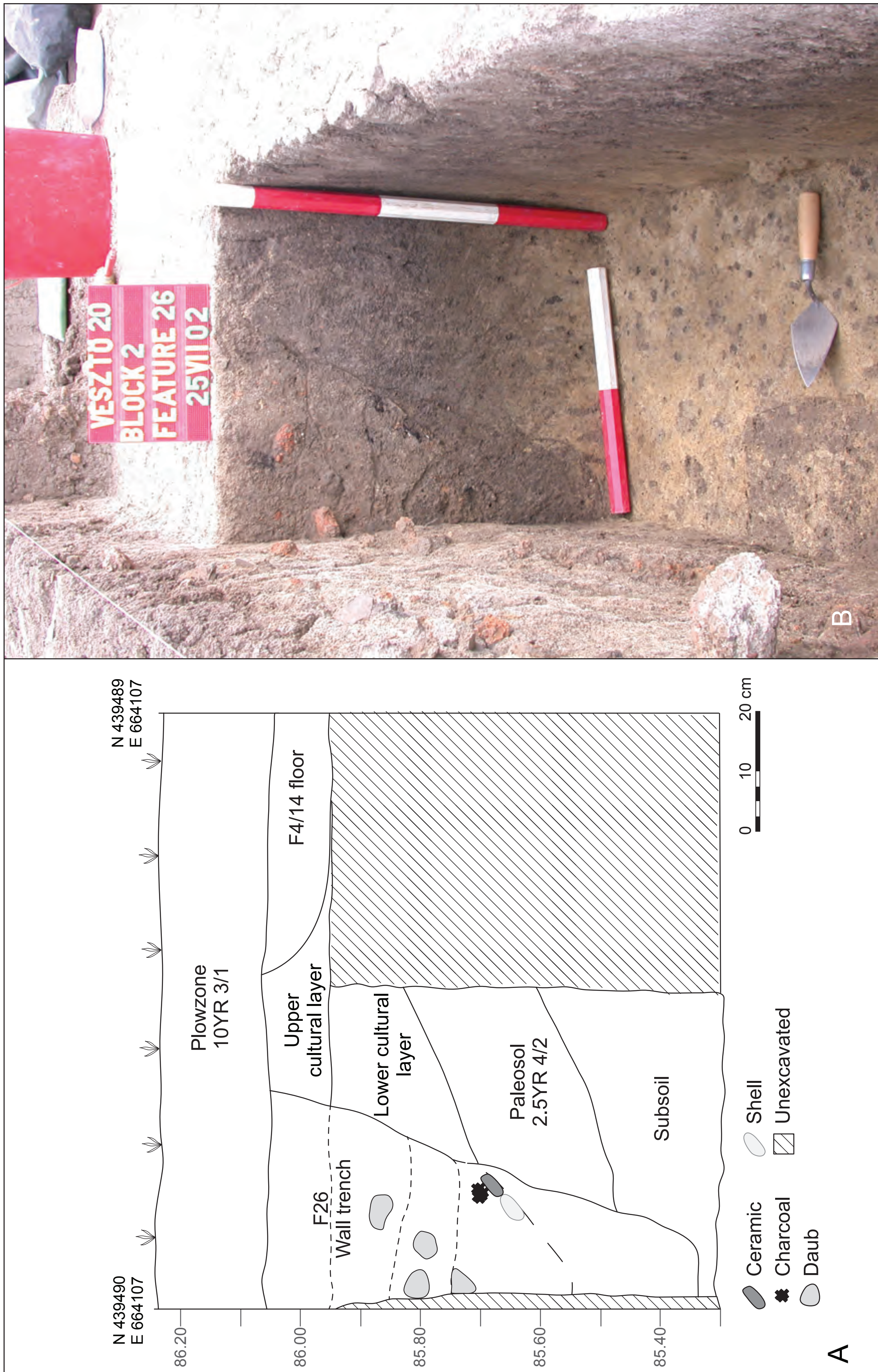


Figure 7.15. Feature 26 wall trench in Block 2 at Vésztő-Bikeri. A: Profile drawing; B: Photograph. Facing east. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

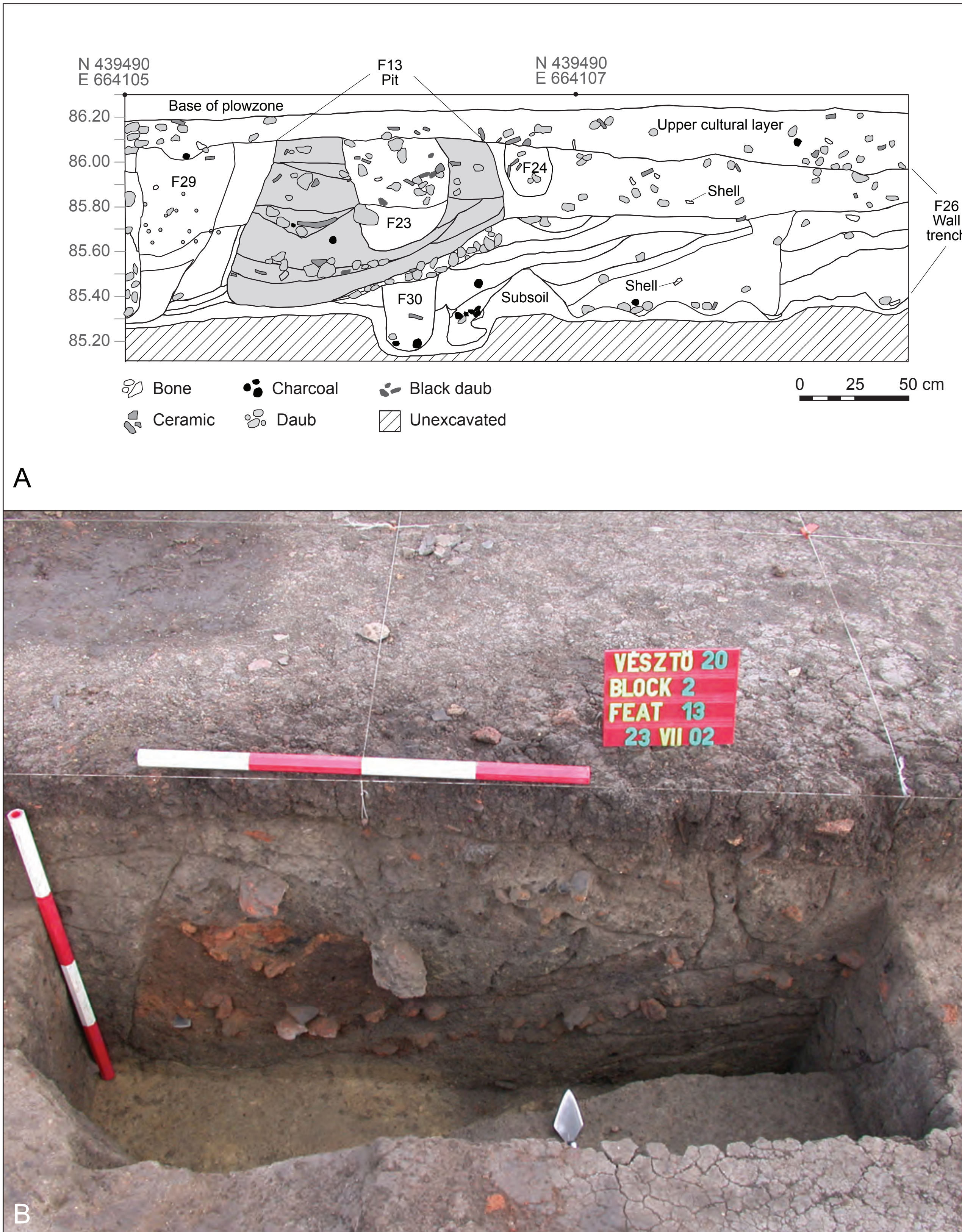


Figure 7.16. A portion of the northern profile of Block 2 at Vésztő-Bikeri showing stratigraphy and Features 13, 24, 26, 29, and 30. A: Profile drawing; B: Photograph of Feature 13 pit during excavation. Facing north. Scale bars indicate 20 cm units. *Figure by Richard W. Yerkes, Jill Seagard, and William A. Parkinson.*

A roughly 6 m-long section of the south wall trench of Feature 4/14 was excavated in Block 2 (Feature 86; Figure 7.18), and a large corner posthole (Feature 94; Figure 7.19) was found at the junction of the south and west wall trenches. The base of this post seems to have burned in situ. The east wall trench of Feature 4/14 was not identified and may have been located outside the excavated area (Figure 7.19).

In sum, the wall trenches of Feature 4/14 were U-shaped in cross-section (Figure 7.20) and extended about 35–50 cm below the floor level, and the postholes, which sometimes penetrated the base of the wall trenches, indicate a wattle-and-daub structure. The excavations of the floor area and the wall trenches suggest that the Feature 4/14 longhouse was approximately 6.4 x 12 m, but the eastern edge of the structure remained undefined. We did not expose features associated with dividing walls, and no information is available regarding the location of the entrance or the structure of the roof. No kilns or hearths were identified inside the building.

Below the floor level of Feature 4/14, we found a more homogeneous, lighter, softer, clayey cultural layer that contained a moderate amount of artifacts, including Early Copper Age ceramics, daub, and animal bones. This lower cultural layer may be associated with settlement activities and leveling prior to the establishment of the building (see Chapter 8, this volume).

An intrusive, southwest–northeast oriented adult male burial with a horse skull and leg bones, as well as several grave goods, dating to the Hungarian Conquest period was found between the areas initially labeled separately as Features 4 and 14 in 2001 (Feature 11; Figure 7.12; Lichtenstein 2004; see also Chapter 16, this volume). This intrusive feature likely contributed to the lack of a continuous daub layer in this section of the Feature 4/14 structure. In 2003, we exposed another Hungarian Conquest period adult male buried with a horse head and leg bones, and various grave goods near the southwestern corner of Block 2 (Feature 108; Figure 7.19; see Chapter 16, this volume). The orientation of this grave was similar to that of Feature 11 and was partly intrusive into the Feature 123 wall trench.

Block 3

The 2000 Block 3 test trench was enlarged to 6 x 6 m in 2001 (Figure 7.4). As in Block 2, the upper part of the plowzone was removed by backhoe. A daub layer less preserved than that associated with Feature 4/14 was identified in the northern portion of the block. A diagonal line of burned daub pieces running northwest–southeast across the center of the block seemed to mark the line of the wall of the Feature 5 structure (Figure 7.21A). Below this daub line, a wall trench was found (Feature 78). Only three postholes were identified within it (Features 91, 92, and 102). Unlike many of the postholes in the wall trenches of Feature 4/14 in Block 2, the bases of the posts did not penetrate through the bottom of the wall trench.

Because the floor level of Feature 5 was not as distinct as it was in Feature 4/14, initially it was not clear whether the interior of the structure was located on the southern or northern side of the Feature 78 wall trench. Further excavations confirmed that the wall trench belonged to the northeastern edge of the structure, although another, less dense daub concentration was identified later at the northern edge of Block 3 (Figure 7.21; see also Figure 8.4). The northern wall of the Feature 5 structure may have fallen outside the structure to the north.

A cluster of complete and fragmentary vessels was recovered from the floor level in the southeastern section of Block 3 (Figure 7.21). This cluster continued to the south beyond the excavation block (Figures 7.22–7.23). As with Feature 4/14, many of these vessels were found upside down, suggesting that they may have fallen from shelves. Five ceramic loom weights and three spindle whorls were recovered from the daub rubble and the floor (see Chapter 13, this volume). A single, complete, unburned antler arrowhead and a needle and spiral ring made of copper were found in the cultural layer above the floor in Block 3 (see Chapters 11 and 13, this volume). The majority of artifacts on the floor in Block 3 were not as burned as they were in Block 2, suggesting that the structure was not burned as intensively.

The semi-flexed skeleton of an infant, buried lying on the left side with two small Early Copper Age vessels, was exposed just north of the Feature 78 wall trench (Feature 85; see Chapter 16, this volume). The grave was identified in the upper cultural layer, but the burial pit could not be defined during excavation.

A 3 x 4 m extension was opened to expand the southeastern portion of Block 3, down to the northern edge of Block 2, in 2002 (Figure 7.4). The goal was to follow the floor level of the Feature 5 structure and try to identify a southwest wall trench parallel to Feature 78. Below the plowzone, a thin cultural layer mixed with daub pieces was found on the top of a hardly recognizable floor level, but no clear wall trench was revealed in the extension. The southwestern edge of Feature 5 may have been where the artifact density dropped off, about 6 m from the Feature 78 inner wall trench (Figure 7.21).

The dimensions of the Feature 5 structure remain unclear, and no entrances, kilns, or hearths were identified during the excavations. As in Block 2, a lower cultural layer was found under the Feature 5 floor level.

Figure 7.17. Photograph of Feature 28 wall trench in Block 2 at Vésztő-Bikeri during excavation. Facing south. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

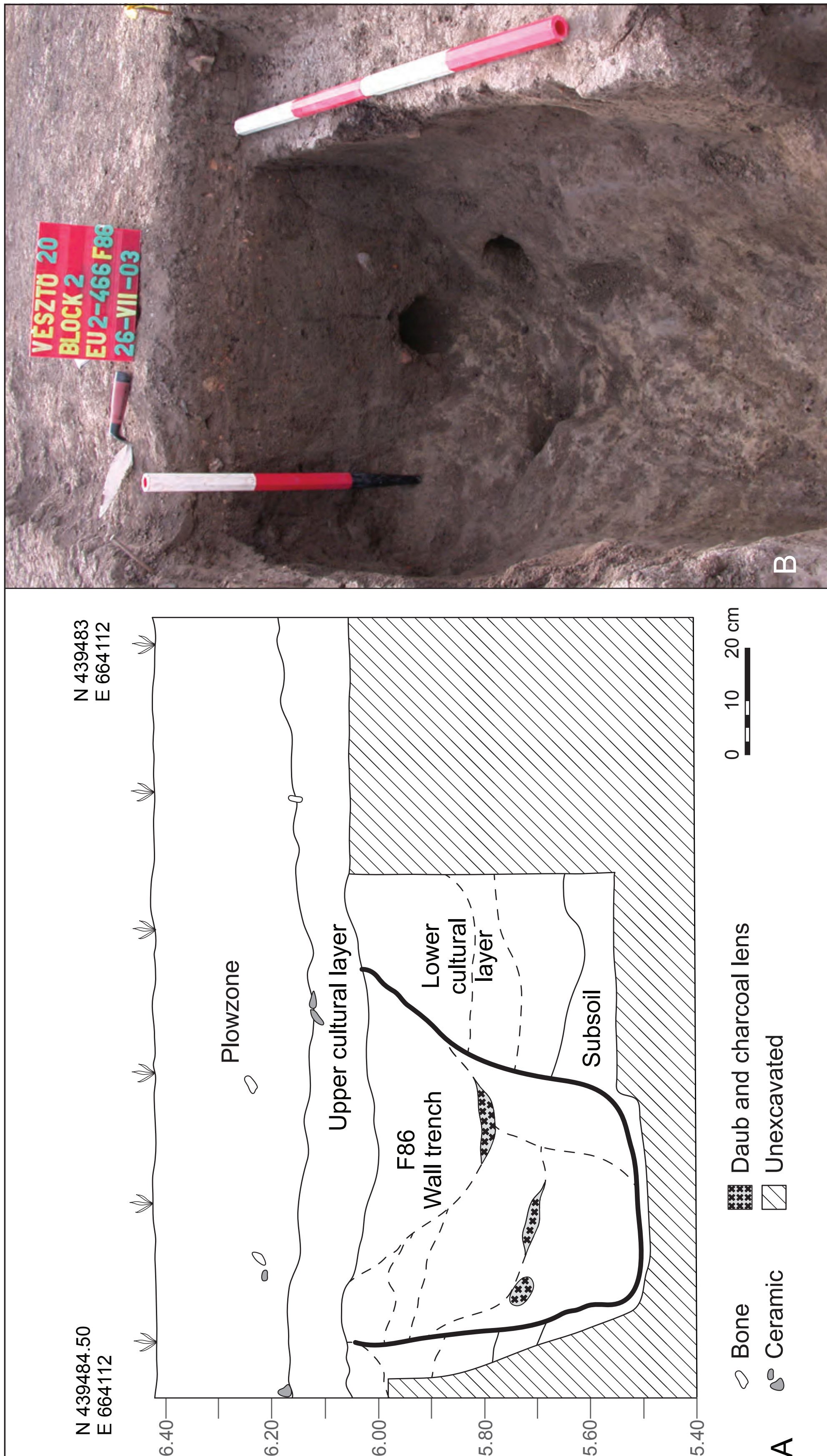


Figure 7.18. Feature 86 wall trench in Block 2 at Vésztő-Bikeri. A: Profile drawing; B: Photograph facing east showing rodent disturbance at base of wall trench fill. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

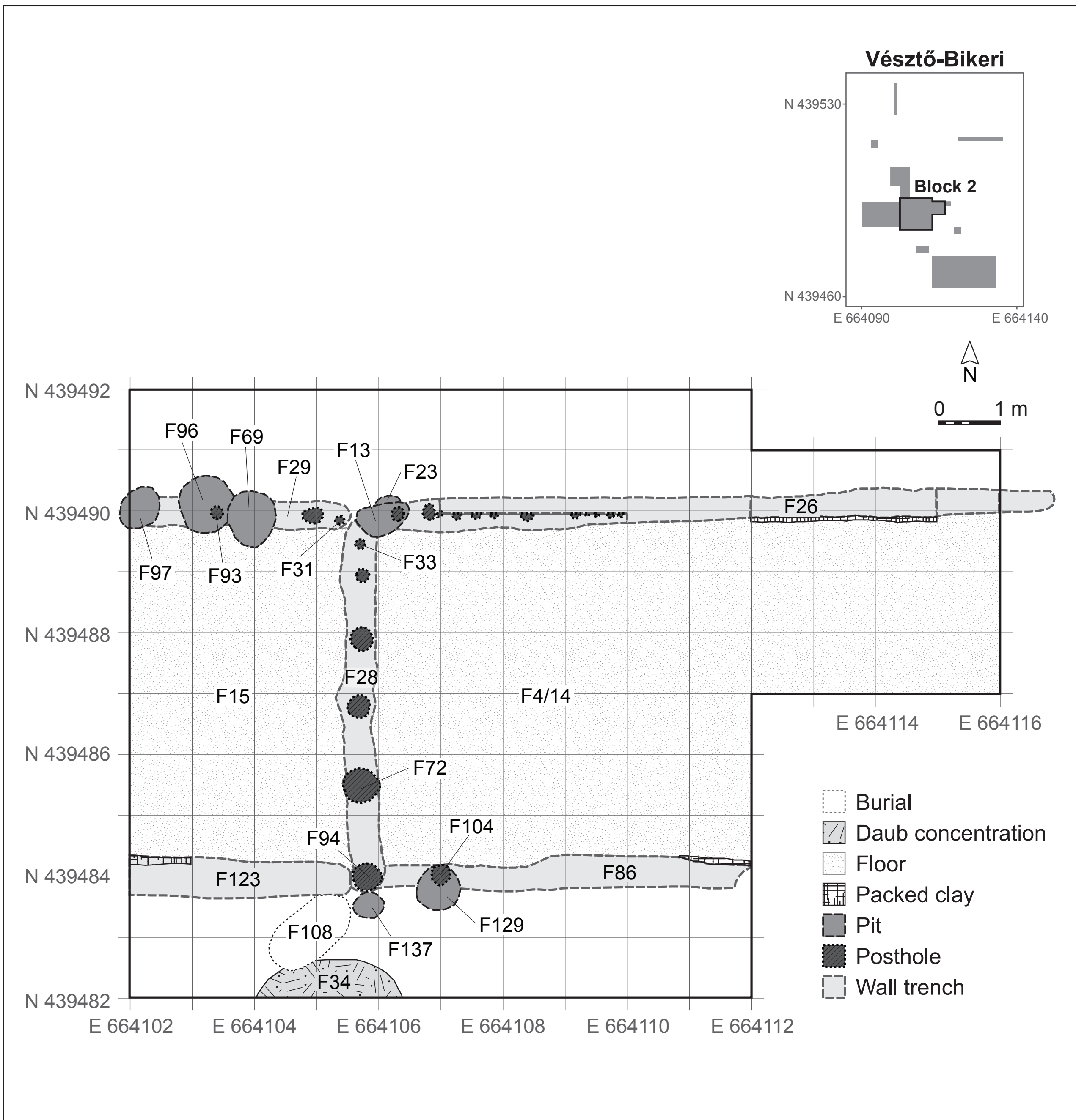


Figure 7.19. Plan map of Block 2 at Vésztő-Bikeri showing the location of features discussed in the text. *Figure by Dorottya Kékegyi and Jill Seagard.*

Figure 7.20. Feature 28 wall trench in Block 2 at Vésztő-Bikeri during excavation. Facing south. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Blocks 5 and 6

The magnetic survey in 2002 revealed multiple circular ditches at the site, suggesting that there may have been defensive structures enclosing the Vésztő-Bikeri village (see Figure 6.3). Two long excavation trenches were laid out to bisect these circular anomalies and identify features associated with them (Figure 7.4). Block 5 was a 1 x 10 m slit trench located in the northern part of the site, and Block 6 was a 1 x 15 m slit trench in the northeastern part of the site. The plowzone was removed by a backhoe, and the sediments below the plowzone were excavated by stratigraphic layers. A relatively deep cultural deposit with very few Early Copper Age artifacts was observed below the plowzone in both blocks, and the ditches were not identified until a depth of about 0.8–1.0 m from the current surface (Figures 7.24–7.25).

As demonstrated by the magnetic survey (see Chapter 6, this volume), several postholes exposed within the inner ditch are associated with the construction of a palisade (Feature 17 in Block 5 and Feature 20 in Block 6; Figures 7.24–7.25). The segments of this inner ditch in the two blocks varied between 40 and 80 cm in width, and they extended up to 1.7 m below the present surface. The postholes within the inner ditch ranged in diameter from 20 to 35 cm and extended

Figure 7.21. Block 3 at Vésztő-Bikeri. A: Plan map; B: Photograph taken during excavation. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*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OVERVIEW
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B

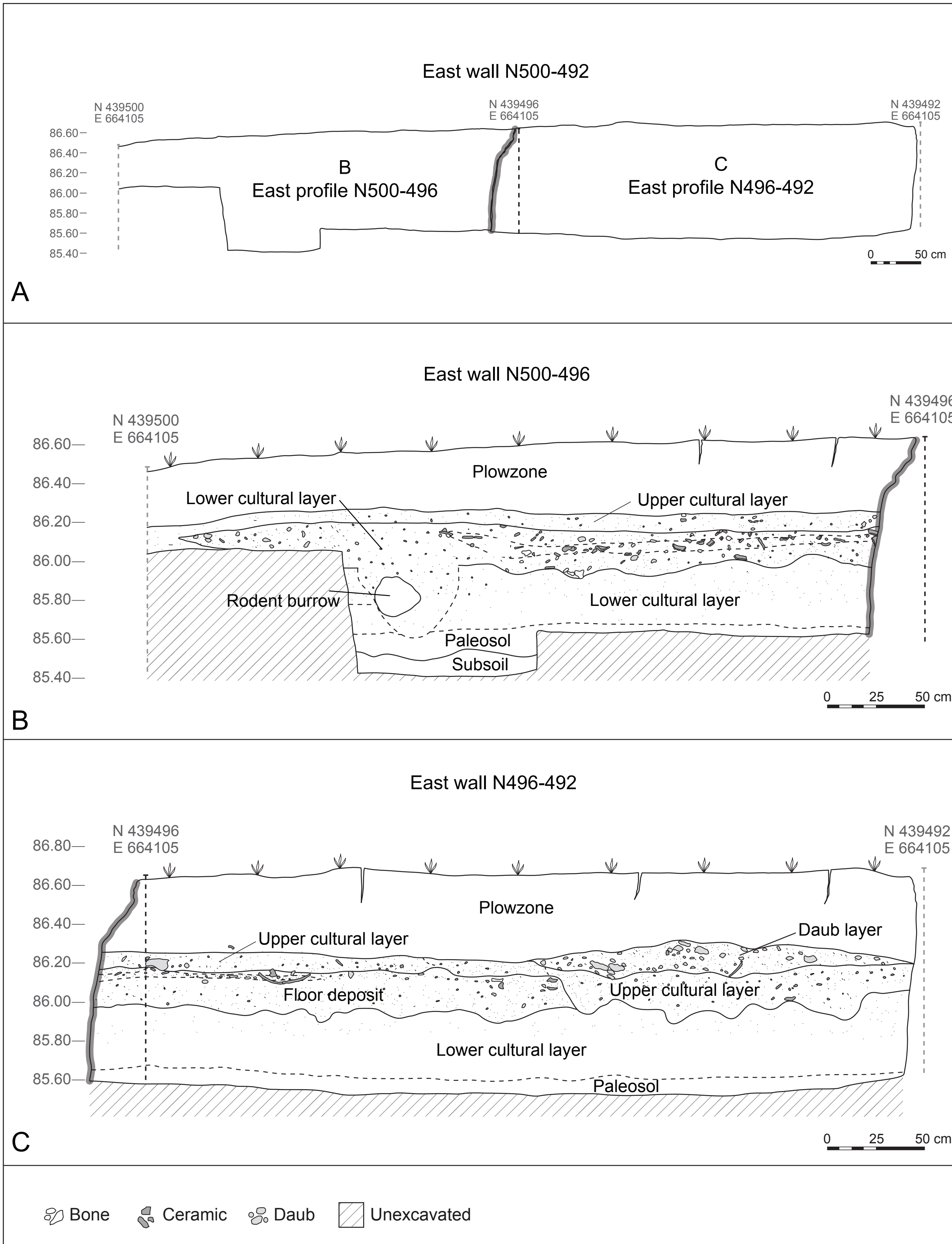


Figure 7.22. East profile of Block 3 at Vésztő-Bikeri. A: Schematic; B: Northern section of east profile; C: Southern section of east profile. *Figure by Jill Seagard.*

Figure 7.23. Photograph of east profile of Block 3 at Vésztő-Bikeri. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

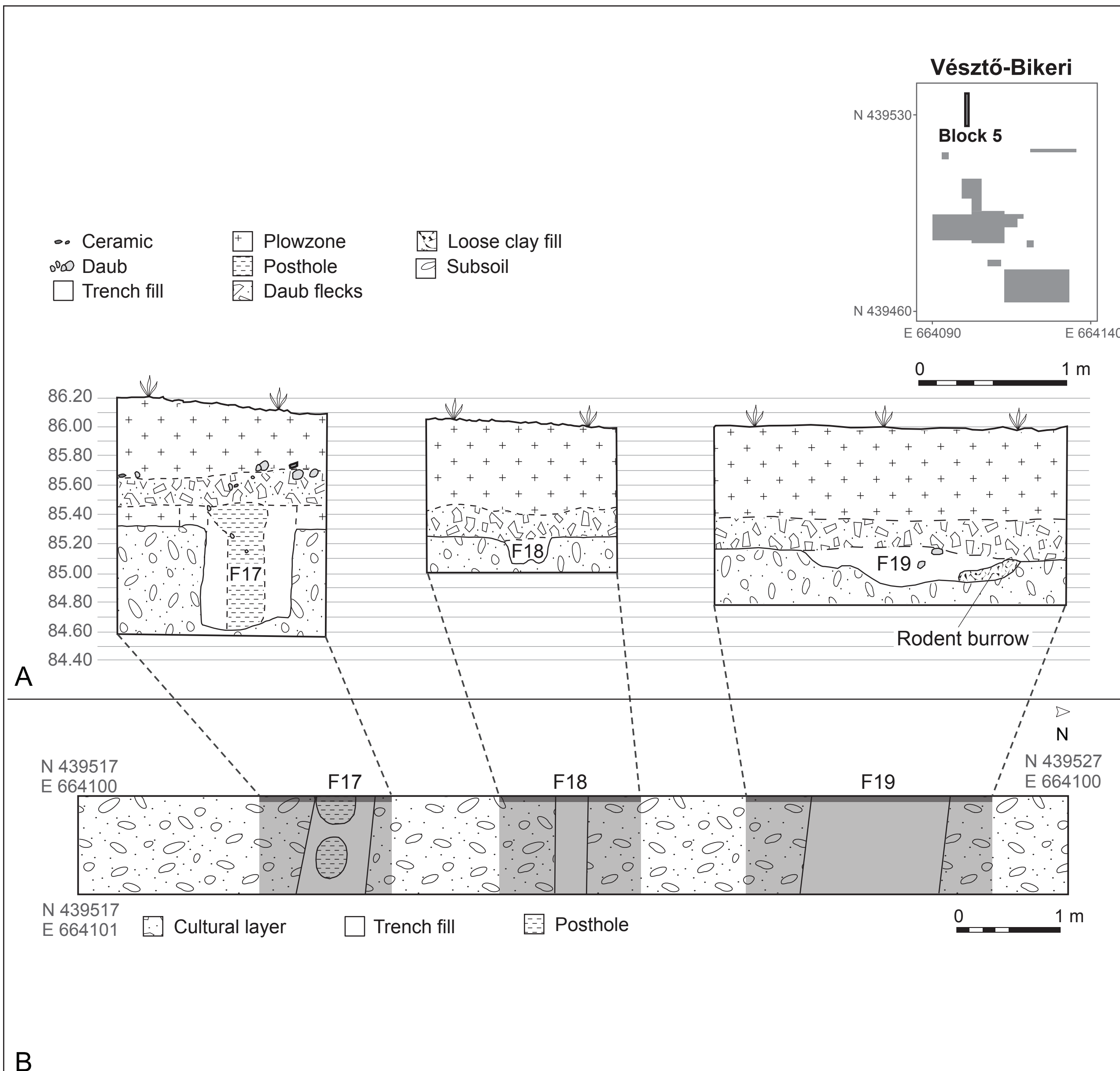


Figure 7.24. Block 5 at Vésztő-Bikeri showing the location of the Feature 17 inner palisade ditch, the Feature 18 middle ditch, and the Feature 19 outer ditch. A: Profile drawings; B: Plan map; C: Photograph facing north. *Figure by Jill Seagard and William A. Parkinson.*

about another 50 cm beneath the bottom of the ditches. The posts were placed about 20–30 cm apart, and based upon their similarity to wall trenches elsewhere on the site, we presume they also supported wattle-and-daub walls.

The outer ditch was trapezoidal to V-shaped in cross-section, up to about 1.5 m wide in some places, and cut to a depth of about 1.5 m below the present surface (Feature 19 in Block 5 and Feature 22 in Block 6; Figures 7.24–7.25). No postholes were identified in the two excavation blocks.

A third, middle ditch was identified in both blocks (Feature 18 in Block 5 and Feature 21 in Block 6; Figures 7.24–7.25). These narrow, shallow features were not detected in the magnetic survey, probably because they were only about 25 to 40 cm wide and extended 15 to 20 cm into the loess subsoil.

A larger amount of Tiszapolgár ceramics, daub, bone, charcoal, and shell was found in the inner and outer ditches, but the artifact density of the ditch fills still was significantly lower than in the features in the central area of the settlement. The middle ditch contained very few artifacts.

Block 7

A 10 x 20 m excavation block was opened in the southeastern part of the site in 2003 to explore a larger segment of the palisade and ditch system that had been identified in Blocks 5 and 6 (Figure 7.4B; see also Figure 6.3). A large number of almost exclusively Early Copper Age artifacts was found in the plowzone and in the 35–40 cm thick cultural layer.

The various elements of the fortification were identified at the top of the subsoil, at a depth of about 75–78 cm below the current surface (Figure 7.26). The outer ditch was 1.45–1.55 m wide with a V-shaped cross-section, and it extended 1.25–1.60 m below the modern surface (Feature 66; Figure 7.26). There were several fill layers in this feature, including an extensive burned lens and some blocks of sterile loess subsoil in what appear to have been basket loads (Figure 7.27).

The inner palisade ditch is located about 5 m toward the center of the site (Feature 88; Figure 7.26). It extended 1.20–1.25 m below the modern surface and 85–95 cm below the base of the plowzone, and it was 40–75 cm wide. This ditch contained closely spaced postholes (Features 80, 117 to 120, 130 to 132, 139 to 143), which were dug into the bottom of the ditch to depths of 1.30–1.75 m below the modern surface (Figure 7.28). The diameters of the postholes ranged between 20 and 30 cm. Several fill layers were revealed in the inner ditch, including redeposited sterile subsoil and packing layers. As noted above, the results indicate that a substantial wattle-and-daub palisade was constructed in this ditch.

An arc of five large postholes spaced 2–3 m apart was identified in the inner ditch (Features 41, 65, 74, 95, and 103; Figure 7.26). The diameters of these postholes ranged from 21 to 30 cm, and they extended 0.9–1.30 m below the modern surface (Figure 7.29). These large posts may have supported an interior wooden platform attached to the palisade. The fill of the postholes and the ditches contained Early Copper Age artifacts as well as animal bones, daub fragments, and charcoal.

An Early Copper Age burial (Feature 71) was placed into one of the previously filled-in platform postholes (Feature 74). The tightly flexed, very possibly bundled adult male was laid on its right side, and a pair of Tiszapolgár ceramic vessels, as well as some freshwater clamshells, and ocher, were placed in the grave (see Chapter 16, this volume). A subadult human long bone also was found in a yellow, compact deposit on top of the inner palisade ditch (Feature 87). In addition, several other features were excavated in Block 7, including the bottom of a pit or posthole located east of the outer ditch (Feature 109); many of these features, however, were associated with rodent disturbances.

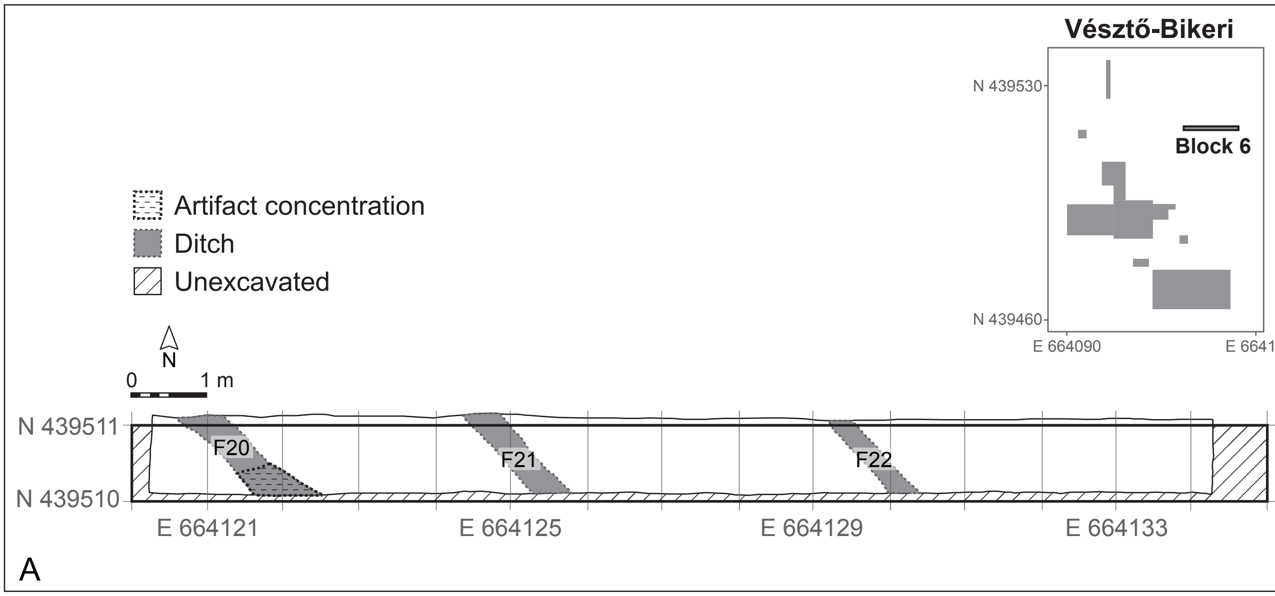


Figure 7.25. Block 6 at Vésztő-Bikeri showing the location of the Feature 20 inner palisade ditch, the Feature 21 middle ditch, and the Feature 22 outer ditch. A: Plan map; B: Photograph. Facing east. Trowel points north. Scale bar indicates 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

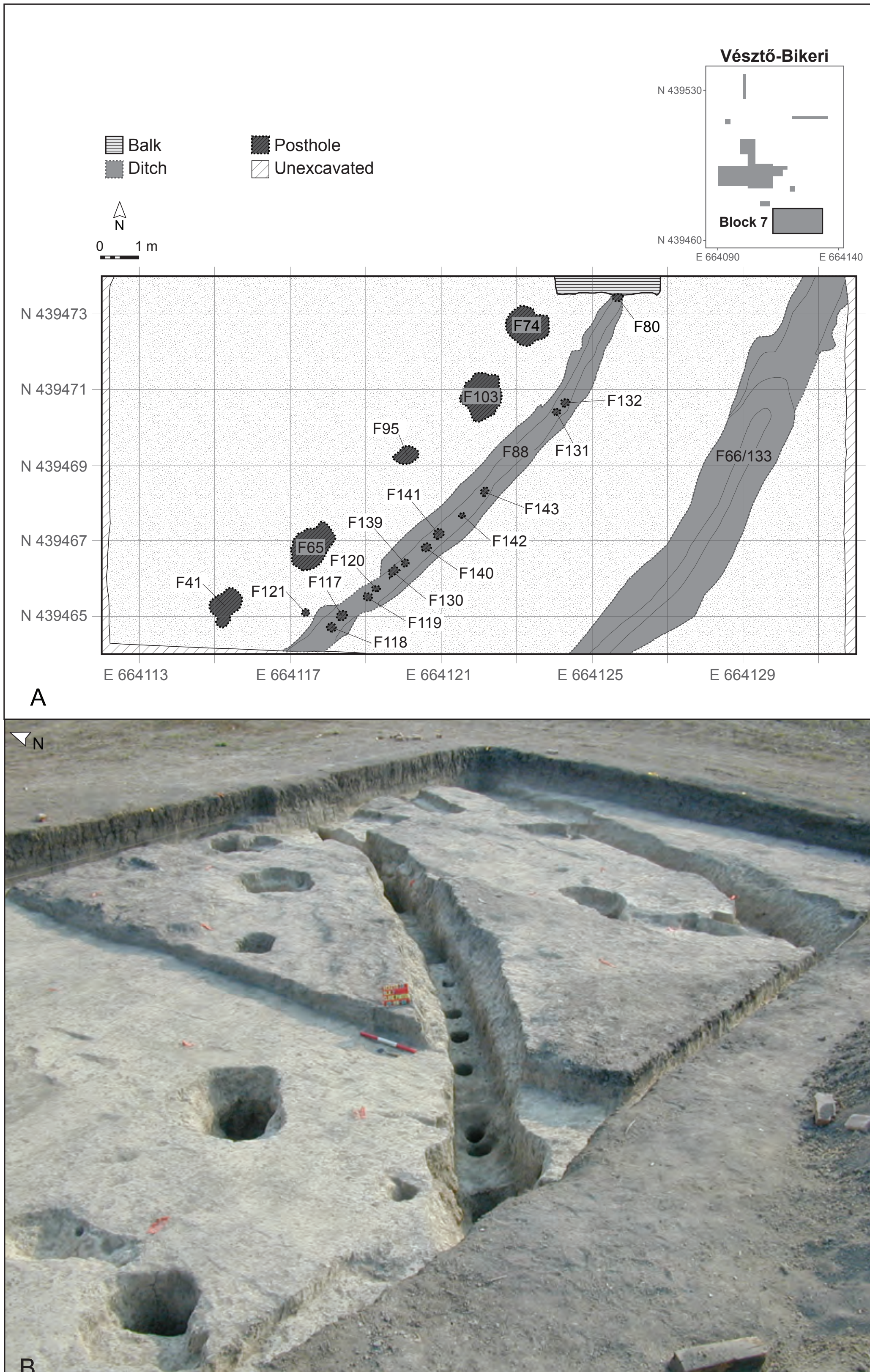


Figure 7.26. Block 7 at Vésztő-Bikeri showing features discussed in the text. A: Plan map; B: Overview photograph of Block 7 facing northeast. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

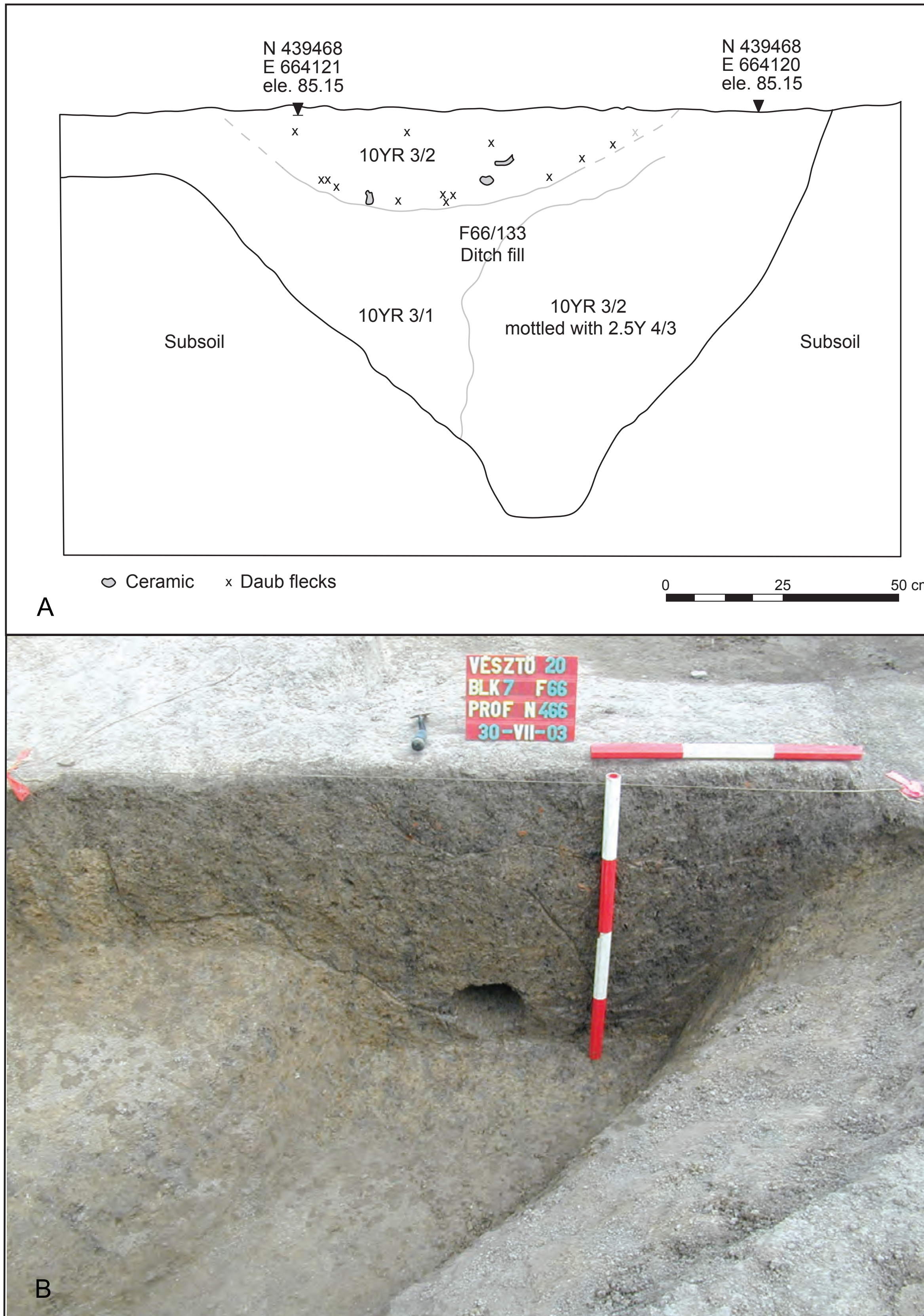


Figure 7.27. North profile of the Feature 66/133 outer ditch in Block 7 at Vésztő-Bikeri. A: Profile drawing; B: Photograph. Facing north. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

Block 8

We opened a 2 x 2 m excavation unit a few meters south of Block 2 in 2003 to explore a strong, circular geophysical anomaly that had been identified as a thermal feature (anomaly B14; Figure 7.4B; see also Chapter 6 and Figure 6.3, this volume). After encountering an ash layer at the base of the plowzone, the block was expanded 2 m to the west, and a circular feature with a diameter of 1.8 m was revealed in the 2 x 4 m block (Feature 151). An Oakfield coring tool was used to determine the depth and to define the cross-section of the feature. The cores showed that Feature 151 was straight-sided or slightly bell shaped, with a curved base, and had a maximum depth of about 3 m below the modern surface. The feature, which we suspect originally was a well or a cistern, was packed with vitrified daub fragments and had a thin, gray, gleyed lens at the bottom.

On top of the burned daub fill, two small kilns or ovens were constructed (Features 35 and 105; Figures 7.30–7.32). The features measured 45 x 70 cm and 50 x 70 cm and were superimposed. They had built, fired-clay walls, and the uppermost, Feature 35, had a hard, baked earthen dome with vents. This uppermost kiln or oven was encountered right below the ash layer at the base of the plowzone.

Block 9

The magnetic survey showed a clear rectangular linear anomaly immediately west of Block 2 (anomaly A3; Figure 7.4B; see also Chapter 6 and Figure 6.3, this volume). Based on our excavation results in Block 2, we interpreted this anomaly as the wall trenches of the western portion of the Feature 15 building identified previously in the western part of Block 2. To fully expose the structure, we opened an 8 x 12 m block in 2003 (Figure 7.4).

Under the plowzone, which was removed with a backhoe, a cultural layer of 20–30 cm was found. The excavation of this upper cultural layer yielded a large amount of artifacts, including Early Copper Age ceramics, animal bones, and some small finds, such as a small copper plate fragment (see Chapter 13, this volume). Below this layer, we exposed the remainder of the east–west oriented Feature 15 longhouse (for details, see Gyucha et al. 2006). The structure measured a total of 6.4 x 14.4 m (Figure 7.33; see also Figure 8.4).

Unlike the wattle-and-daub houses of Features 4/14 and 5, which were partially burned, this *pisé de terre* (that is, rammed earth) structure seems to have been dismantled and abandoned but not burned. Segments of the *pisé* walls were preserved 10–30 cm in height and 30–50 cm in width (Figures 7.33–7.35). Daub fragments and Early Copper Age ceramics, including large sherds, were found in secondary contexts inside these wall remnants. Postholes also were documented inside the wall structures.

Below these standing wall remains, wall trenches (Features 29, 123, and 152) were excavated, with traces of large posts (Features 31, 33, 72, 97, 107, 111 to 114, 124, 125, and 135) that were used to support the rammed earth walls (Figures 7.36–7.37). Some posts extended into the bottom of the wall trenches. Concentrations of large daub fragments were stamped around the base of the posts, possibly to reinforce or shift the posts inside the holes. The cross-section of the postholes suggests that the posts had been removed and were reused, possibly during the construction of Feature 4/14.

The wall trenches of Feature 15 were U-shaped in cross-section, their width was 55–70 cm at the top and 30–40 cm at the bottom, and their depth measured 40–70 cm—commonly 55–65 cm—below the floor level (Figures 7.36–7.37). A diverging section of the wall trench and a posthole (Feature 112) in the southwestern corner indicate that the structure was remodeled or rebuilt. Features associated with an entrance to the structure were not identified.

As with Feature 4/14 in Block 2 and Feature 5 in Block 3, the floor of the Feature 15 structure was very thin and difficult to follow. Although direct evidence is missing, it is possible that wooden planks, woven mats, or animal hides covered the floor. No ovens or hearths were found inside the structure. In situ artifacts were not discovered in a primary context on the floor of Feature 15, and as opposed to Blocks 2 and 3, the assemblage from Block 9 is very fragmented. A more compact walking surface also was identified outside the structure.

The stratigraphy in Block 2 indicates that the Feature 15 longhouse predated the Feature 4/14 structure. Several features that postdate Feature 15 were identified in the upper cultural layer that covered the longhouse. These features were dug after the abandonment, dismantling, and leveling of the structure. Two larger pits cut through the wall remains in the western section and in the northwestern corner (Features 100 and 128; Figure 7.38). Feature 128 had an unusual dark fill and contained a large number of Early Copper Age ceramics, daub, and animal bones. The small Feature 98 pit extended into the external walking surface along the southern edge of Block 9. In addition to Tiszapolgár ceramics and animal bones, an antler arrowhead, possibly manufactured in Feature 4/14 (see above), was recovered from the fill of this feature (Figure 7.38). Feature 127, a short, narrow section of a ditch,

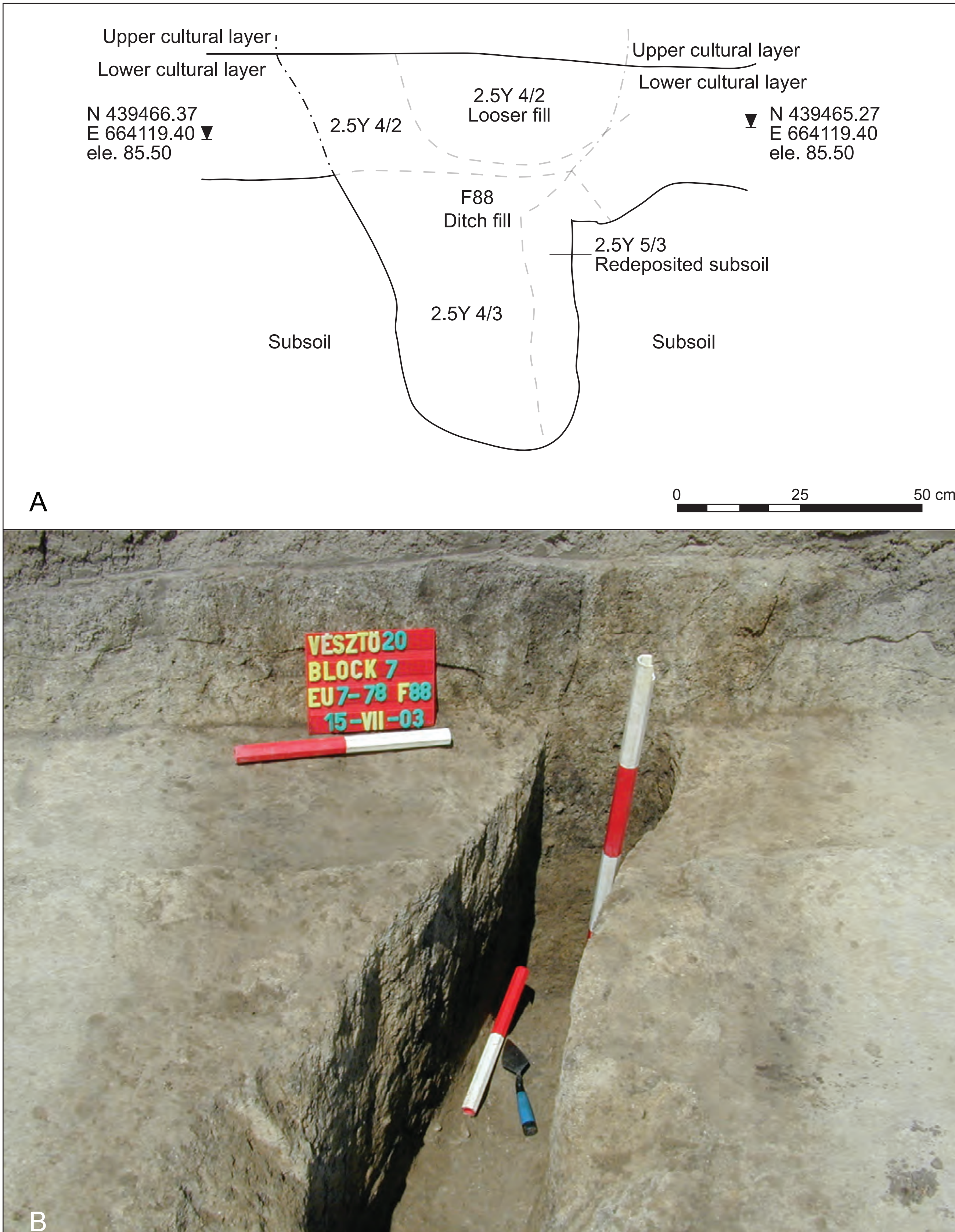

Upper cultural layer
Lower cultural layer
N 439466.37
E 664119.40
ele. 85.50
2.5Y 4/2
2.5Y 4/2
Looser fill
Upper cultural layer
Lower cultural layer
N 439465.27
E 664119.40
ele. 85.50
F88
Ditch fill
2.5Y 5/3
Redeposited subsoil
2.5Y 4/3
Subsoil
Subsoil
A
0
25
50 cm
VESZTŐ 20
BLOCK 7
EU 7-78 F88
15-VII-03
B

Figure 7.28. Feature 88 inner ditch in Block 7 at Vésztő-Bikeri. A: Drawing of north profile; B: Photograph (both on opposite page); C: Photograph of palisade ditch with postholes during excavation. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

predates Feature 15. The ditch fill contained Tiszapolgár sherds and animal bones, and the feature originated below the walking level outside Feature 15, between the northern wall trench of Feature 15 and the edge of the block. An intrusive pit with the skeleton of a pig with two iron nose rings, dating to historic or modern times, cut through the floor of Feature 15 in the northeastern section (Feature 90).

We opened a 2 x 2 m excavation unit in the central-eastern part of Block 9 to explore a possible partition wall in Feature 15 and to acquire data on the stratigraphy below the floor level. No indication of a partition wall was identified, although we did find a small portion of a pit, which may have been contemporaneous with or somewhat later than the Feature 15 longhouse (Feature 149; Figure 7.39). We also exposed an oval-shaped pit that contained only faunal remains (Feature 150; Figure 7.39). This feature was excavated from the top of the paleosol, thus representing the oldest occupation phase at the site (see Chapter 8, this volume).

Between the floor level and the paleosol, a 20–30 cm thick cultural deposit with a moderate number of Early Copper Age artifacts was identified. This lower cultural layer may have been associated with the early phase of habitation during the Early Copper Age at the site and/or sediment redeposition and leveling activities that preceded the construction of Feature 15 (see Chapter 8, this volume).

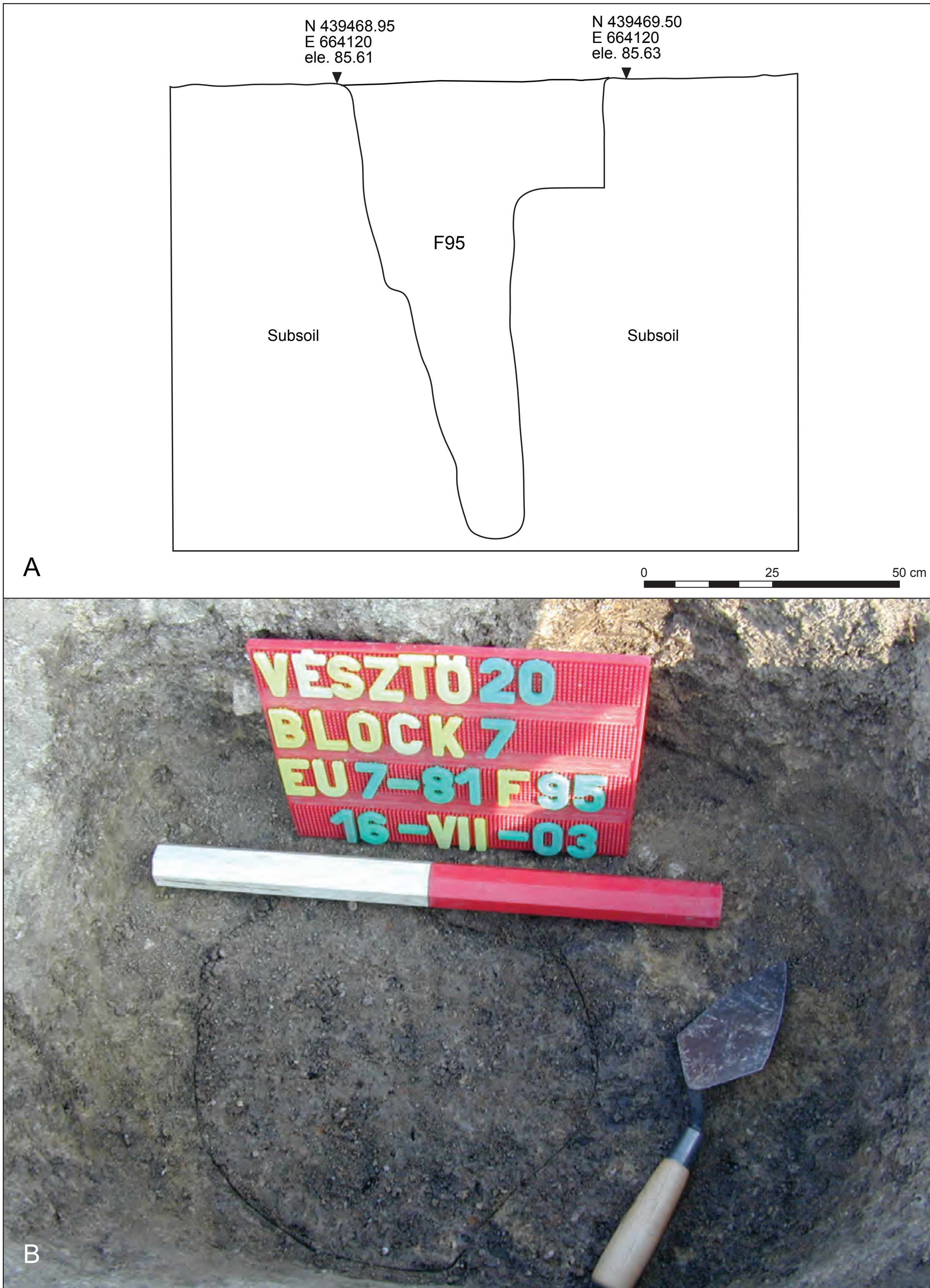


Figure 7.29. Feature 95 posthole in Block 7 at Vésztő-Bikeri. A: Profile drawing. B: Photograph during excavation. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

Figure 7.30. Photograph of Feature 35 thermal feature in Block 8 at Vésztő-Bikeri. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

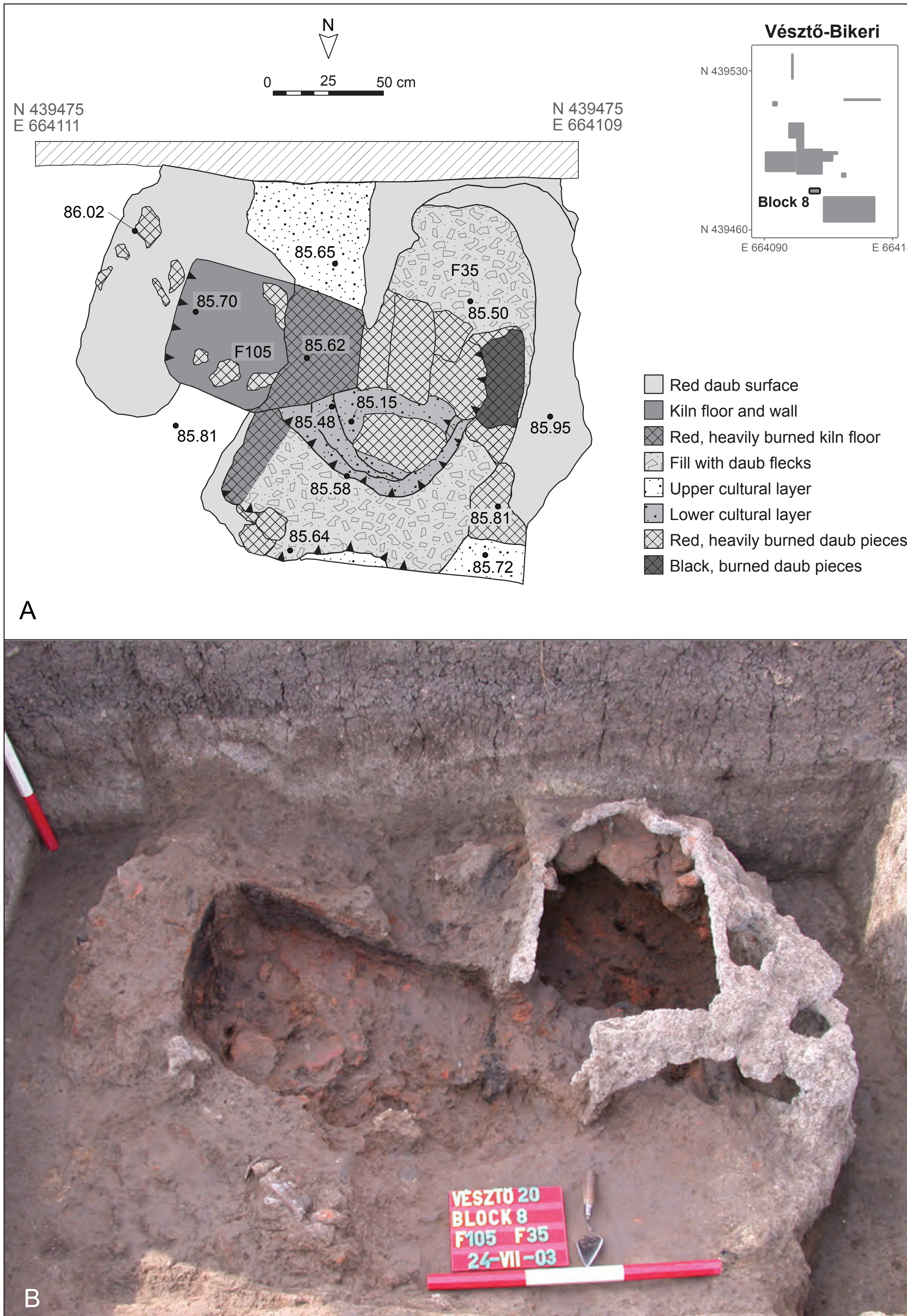


Figure 7.31. Feature 35 and Feature 105 thermal features in Block 8 at Vésztő-Bikeri. A: Plan map; B: Photograph. Facing south. Trowel points north. Scale bars indicate 20 cm units. *Figure by Dorottya Kékegyi, Jill Seagard, and William A. Parkinson.*

Figure 7.32. Photograph of Feature 35 thermal feature showing vents in Block 8 at Vésztő-Bikeri. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

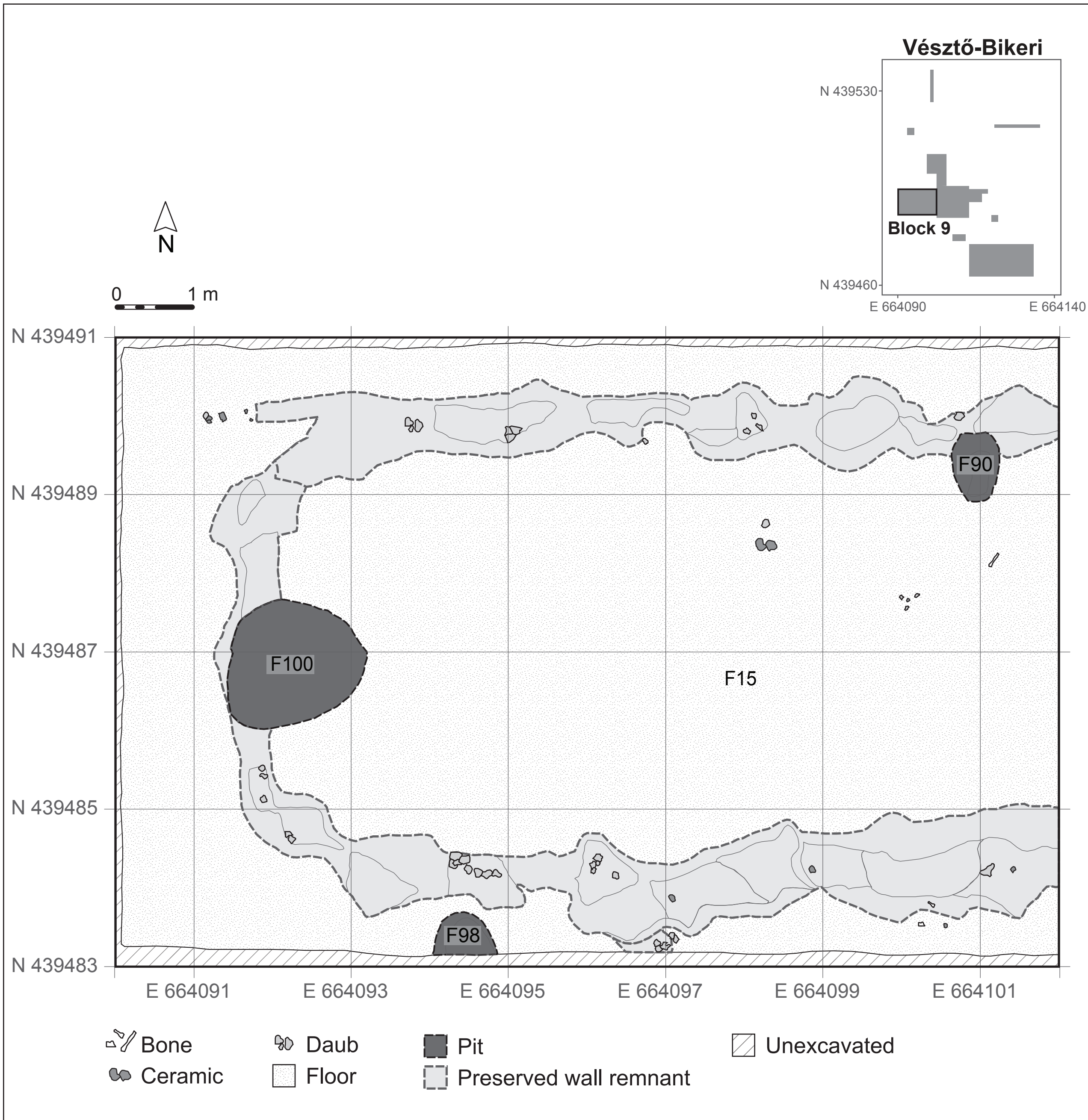


Figure 7.33. Plan map of Block 9 at Vésztő-Bikeri showing wall remnants from the Feature 15 longhouse. *Figure by Dorottya Kékegyi and Jill Seagard.*

Figure 7.34. Photograph of preserved wall remnants of the Feature 15 longhouse in Block 9 at Vésztő-Bikeri. Facing west. *Figure by William A. Parkinson.*

Figure 7.35. Photograph of the Feature 15 longhouse in Block 9 at Vésztő-Bikeri during excavation showing preserved wall remnants. Facing east. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Figure 7.36. Photograph of the Feature 15 longhouse in Block 9 at Vésztő-Bikeri after excavation showing wall trenches. Facing east. Trowel points north. Scale bars indicate 20 cm units. Block 9 is in the foreground. Block 2 is in the background. *Figure by William A. Parkinson.*

Figure 7.37. Photograph of the western wall trench of the Feature 15 longhouse after excavation. Facing south. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Figure 7.38. Photograph of Feature 128 pit in Block 9 at Vésztő-Bikeri. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

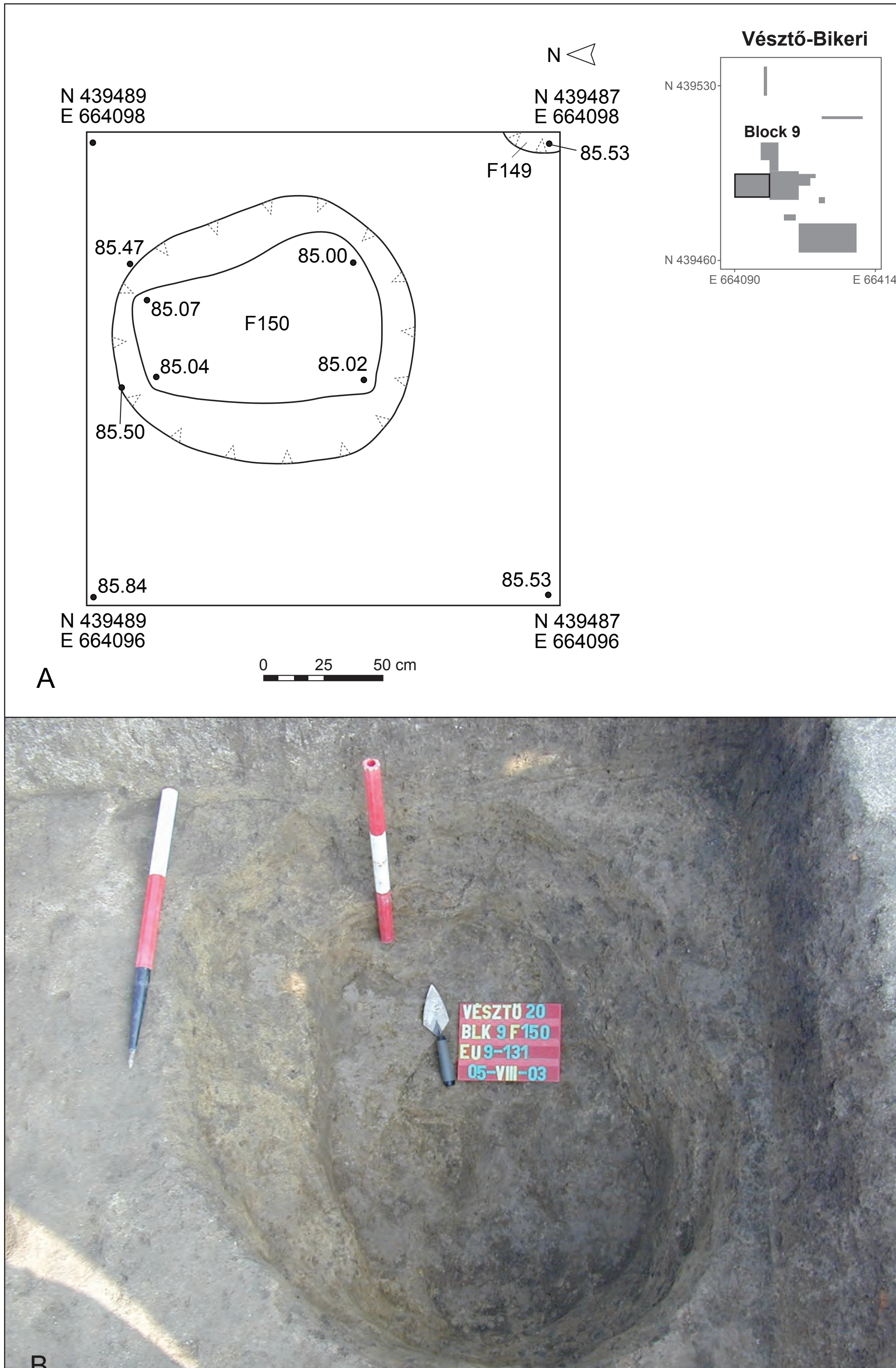


Figure 7.39. Features 149 and 150 pits in Block 9 at Vésztő-Bikeri. A: Plan map; B: Photograph of Feature 150. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

Excavations at Körösladány-Bikeri

In addition to expanding our work at Vésztő-Bikeri, we also carried out test excavations at Körösladány-Bikeri in 2001. Based on the results of these excavations and the surface collection in 1998, gridded surface collections and geophysical and geochemical studies were conducted from 2003 to 2005 at the site (see Chapters 4 to 6, this volume). Subsequent, large-scale excavations took place in 2005 and 2006 (Figure 7.4). Detailed information about each excavated feature at Körösladány-Bikeri is presented in Appendixes IV and VI.

Test Excavations at Körösladány-Bikeri

Two 2 x 2 m test units (Blocks 1 and 2) were opened in the northern part of the site (Figure 7.4), in and near Surface Feature 1, which was characterized by concentrations of burned daub and Tiszapolgár ceramics on the surface in 1998 (see Chapter 4, this volume). No daub layer, floor level, or other features were identified in this test unit; only an intact cultural layer of dark clayey silt, about 15–20 cm thick, was found above the subsoil (Figure 7.40). Probing with an Oakfield hand coring tool to a depth of about 2 m did not identify any buried cultural horizons. The density of Tiszapolgár artifacts in the plowzone and in the cultural layer in Block 1 at Körösladány-Bikeri was much lower than in the test units at Vésztő-Bikeri. However, roughly the same number of faunal remains recovered in Block 1 at Vésztő-Bikeri came from in this unit. A sherd from the Sarmatian period (second to fourth century AD) and scattered human bones also were found in the plowzone.

The second test trench at Körösladány-Bikeri, Block 2, was opened 4 m northwest of Block 1. No clear daub layer or floor level was exposed in this test unit either, but a concentration of daub mixed with animal bones and Early Copper Age ceramics was found near and immediately below the base of the plowzone within a very dark, clayey, silty, intact cultural layer, about 10–15 cm thick, in the northern section of the test unit (Figure 7.41).

Large-Scale Excavations at Körösladány-Bikeri

The geophysical survey identified circular anomalies around the Körösladány-Bikeri settlement similar to those identified at Vésztő-Bikeri (see Chapter 6, this volume), which were associated with the excavated ditches and palisades. The magnetic map verified that the two 2001 test units, Blocks 1 and 2, were located just outside the outermost circular enclosure anomaly, beyond the Early Copper Age settlement limits (Figure 7.4B). Guided by the results of the preliminary investigations, an additional five blocks were excavated at Körösladány-Bikeri: Block 3 was laid out and excavated in 2005, Blocks 4 and 5 in 2005 and 2006, and Blocks 6 and 7 in 2006 (Figure 7.4). More than 90 percent of the ceramic assemblage from the site dates to the Early Copper Age and the rest represents the Early Neolithic, Late Bronze Age, Sarmatian period, Árpádian Age, Middle Ages, and the modern period (see Chapter 9, this volume). The Late Bronze Age and Sarmatian artifacts commonly were recovered from several pit features, whereas objects dating to other periods were found in the plowzone and the cultural layer.

Block 3

A 5 x 9 m block was opened where a large monopole anomaly with a strong magnetic signature was identified in the northern section of the site (anomaly K28; Figure 7.4; see also Chapter 6 and Figure 6.5, this volume). When the plowzone was removed, a large pit became visible. Partial excavation of the feature confirmed that it dates to the Sarmatian period (Feature 6; see Figure 8.10). An anomaly located northeast of the Sarmatian pit also was exposed (Feature 3; see Figure 8.10). The small pit contained a hoard of three nested, Late Bronze Age Gáva culture ceramic drinking vessels. A shallow feature that postdates the Sarmatian period also was identified east of Feature 6 (Feature 15).

There were a few Early Copper Age features in Block 3. A circular cluster of Tiszapolgár ceramics, daub, and animal bones, about 1 m in diameter (Feature 7; see Figure 8.9), and a small, circular, Early Copper Age pit (Feature 16; see Figure 8.9) were encountered in or near the top of the lower cultural layer. Feature 16 may have been dug to remove the post from a posthole found in the middle of the pit (Feature 18; see Figure 8.9). All these Tiszapolgár features may be associated with the initial Early Copper Age occupation episode at Körösladány-Bikeri. The scattered remains of an infant were found within the upper cultural layer in Block 3 (Feature 1; see Figure 8.9; see also Chapter 16, this volume). The chronological position of this burial remains ambiguous.

Block 4

A 5 x 8 m block was opened in the southeastern section of the site over a rectangular, high-gradient anomaly (anomaly K17; Figure 7.4; see also Chapter 6 and Figure 6.5, this volume). At the southern end of Block 4, the excavations revealed a 6 m long section of a northeast–southwest oriented ditch (Feature 29). The ditch contained four features, of which three definitely were postholes (Features 37 to 39, and 42; Figure 7.42). It remained

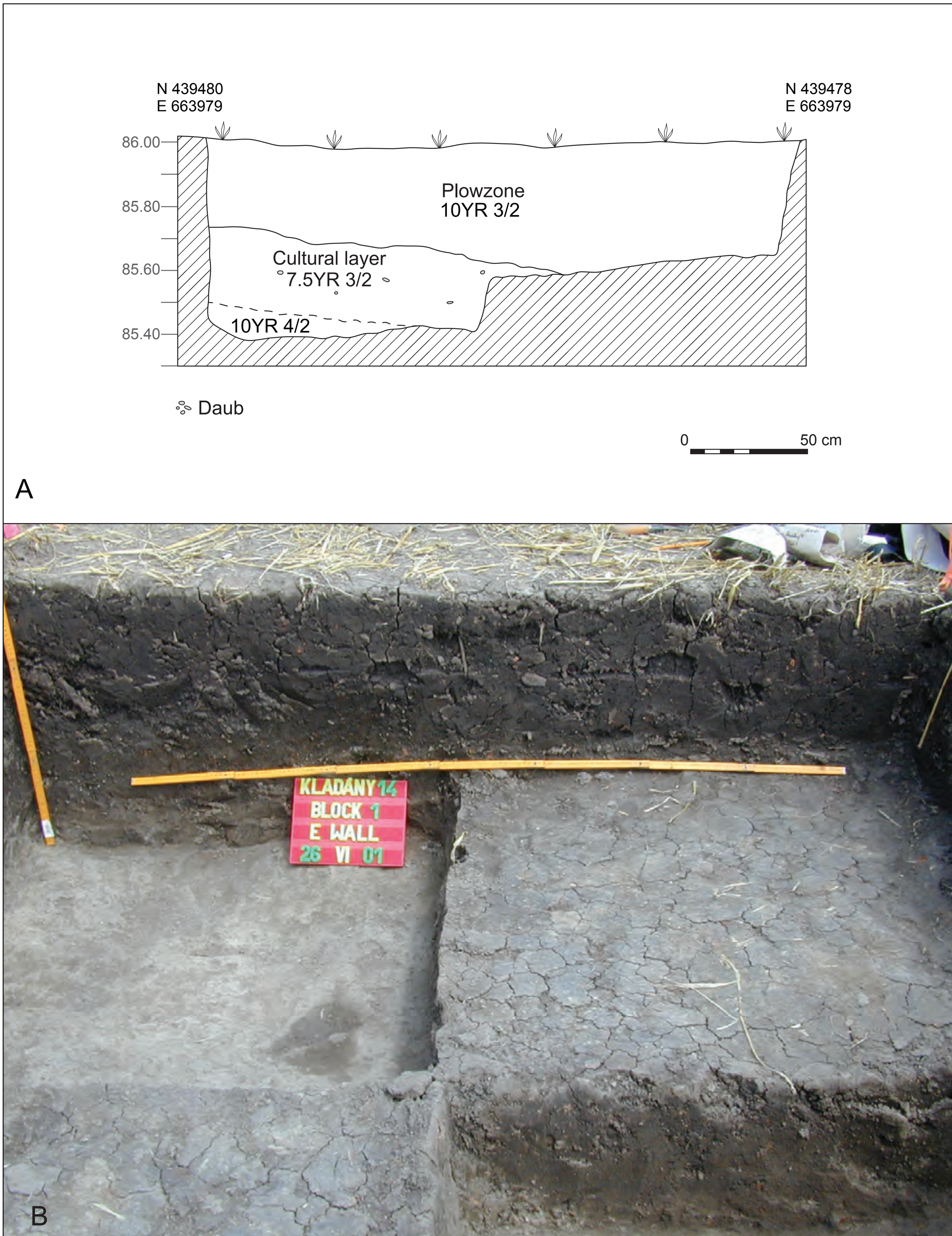


Figure 7.40. East profile of Block 1 test excavation trench at Körösladány-Bikeri. A: Profile drawing; B: Photograph. Facing east. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

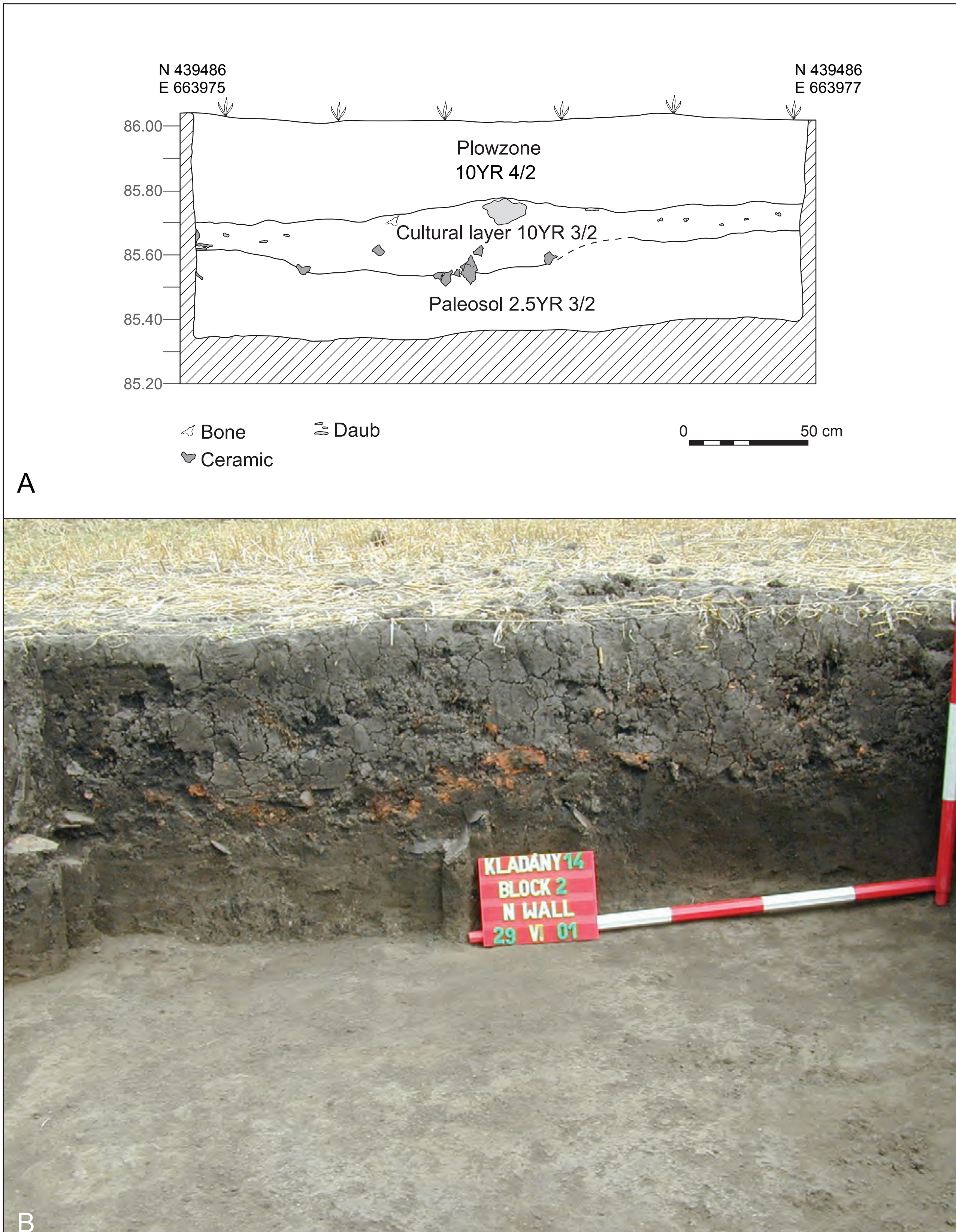


Figure 7.41. North profile of Block 2 test excavation trench at Körösladány-Bikeri. A: Profile drawing; B: Photograph. Facing north. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

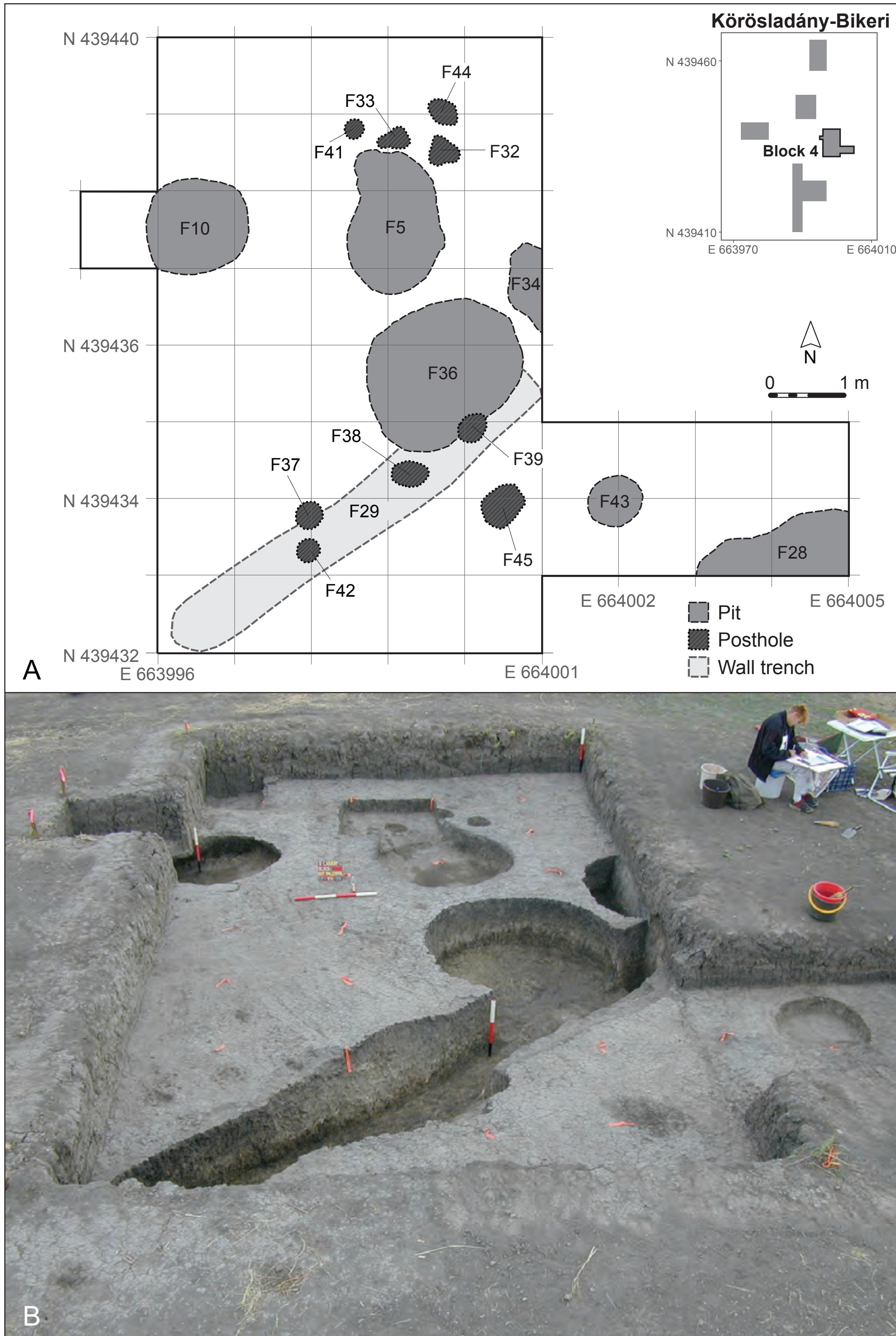


Figure 7.42. Block 4 at Körösladány-Bikeri. A: Plan map showing features at the final stage of excavation; B: Overview photograph after excavation. Facing north. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

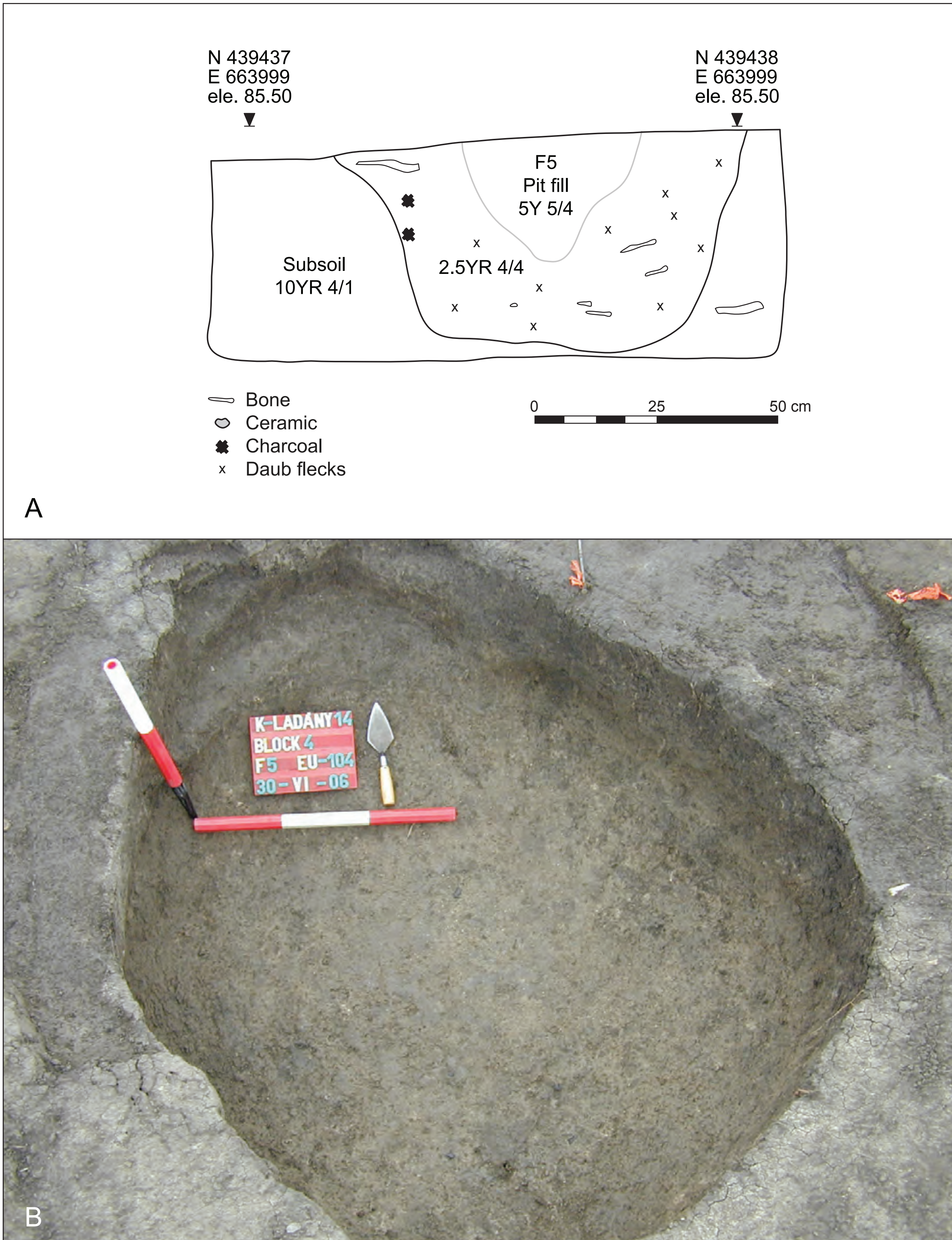


Figure 7.43. Feature 5 pit in Block 4 at Körösladány-Bikeri. A: Profile drawing; B: Photograph. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

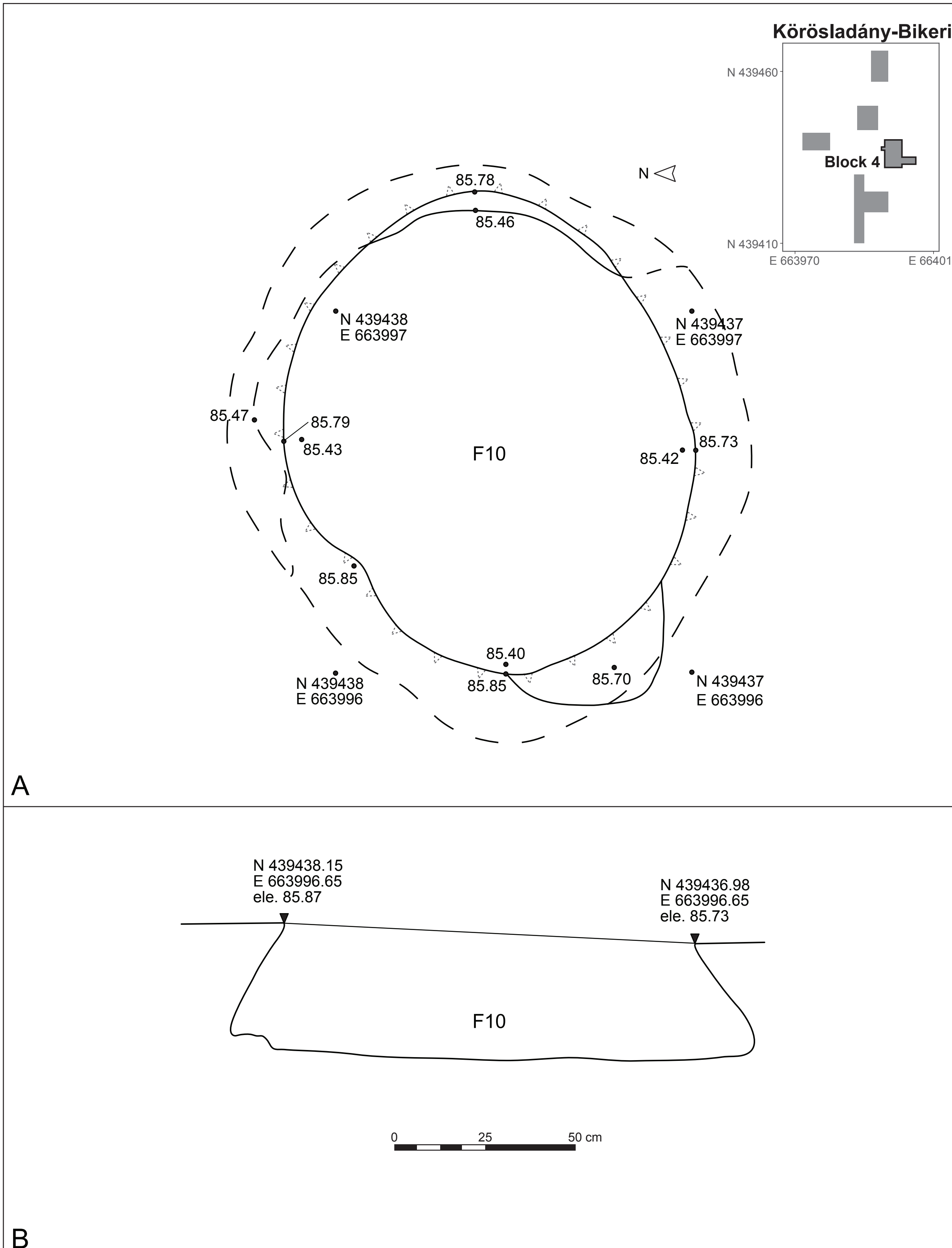


Figure 7.44. Feature 10 bell-shaped pit in Block 4 at Körösladány-Bikeri. A: Plan map; B: Profile drawing. *Figure by Jill Seagard.*

unclear whether the Feature 29 ditch belonged to a structure. Just southeast of Feature 29, a pit or posthole was exposed (Feature 45; Figure 7.42). The feature had been dug through the paleosol and was damaged by a rodent disturbance. Other settlement features include two shallow postholes (Features 41 and 44; Figure 7.42) and two small pits (Features 32 and 33; Figure 7.42) in the northernmost section of Block 4. It remains unclear whether the postholes were associated with a structure. Another pit extended into the eastern profile of the excavation block (Feature 34; Figure 7.42). All these features contained Early Copper Age materials and were exposed in the lower section of the cultural layer.

In the northern part of Block 4, two bell-shaped Early Copper Age pits, Features 5 and 10, were exposed (Figure 7.42). Feature 5 contained a high concentration of burned material, including ash and charcoal, as well as daub fragments, animal bones, shells, and Tiszapolgár ceramics (Figure 7.43). Several big chunks of Tiszapolgár sherds, animal bones, and fish remains, as well as several lithics and ground stones, were found in a dark, loose, loamy fill just below a yellow, packed subsoil cap in Feature 10 along the western wall of the block (Figures 7.44–7.45). Due to the unique characteristics of the feature, a 1 x 1 m extension was added to the block to fully expose the pit. A posthole was found at the bottom of the pit (Feature 27), suggesting that it likely was reused as a storage/garbage pit after the post was pulled out. A small portion of a pit was also excavated along the eastern edge of the excavation block (Feature 13; see Figure 8.9). All these Early Copper Age features had been cut through the upper cultural layer and were truncated by plowing. A copper needle also was recovered from the upper cultural layer in the southern part of the block (see Chapter 13, this volume).

Near the center of the block, another feature was encountered immediately below the plowzone. This large, circular pit dates to the Sarmatian period and contained both Gáva and Sarmatian ceramics (Feature 36; Figure 7.42; see also Figure 8.10). An ice skate made of a modified horse metapodial, typical of the Sarmatian period, also was found in this feature.

When the upper cultural layer was excavated in the southeastern section of Block 4, an artifact cluster of ceramic cups, antler, animal bones, and grinding stones was found on top of the lower cultural layer without a detectable pit (Feature 4). This feature may have been spatially associated with two burials (Features 11 and 12; see Figure 8.8; see also Chapter 16, this volume). The two flexed infant skeletons lying on their right sides were exposed on the same surface as the Feature 4 artifact cluster and were

Figure 7.45. Photograph of Feature 10 pit in Block 4 at Körösladány-Bikeri. Facing southwest. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

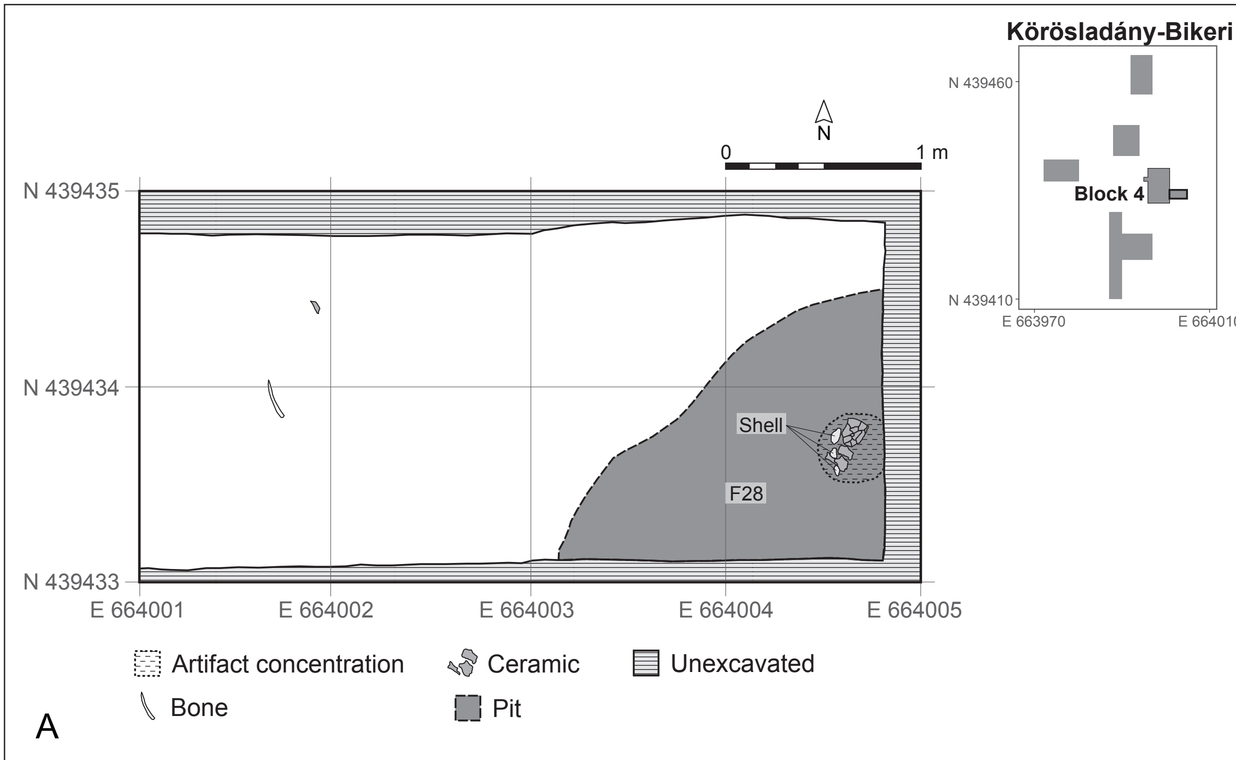


Figure 7.46. Feature 28 pit in Block 4 at Körösladány-Bikeri. A: Plan map; B: Photograph during excavation. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Figure 7.47. Photograph of Feature 43 pit in Block 4 at Körösladány-Bikeri. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

covered with Tiszapolgár vessels (a flaring bowl and half of a large pot). Burial pits were not identified. Based on the spatial arrangement, it is possible that the bodies were placed in very shallow pits or on the ancient ground surface and then were mounded over using sediments mixed with Early Copper Age cultural material.

To determine whether more burials were placed in this area of the site, a 2 x 4 m extension was added to the southeastern part of Block 4 in 2006 (Figure 7.42). Additional graves were not identified, but more Tiszapolgár pits were exposed in this area. The northwestern section of a large bell-shaped pit was found along the southern and eastern edges of the extension (Feature 28; Figure 7.46). This presumably circular feature contained a layered fill that included large amounts of clamshells and Tiszapolgár sherds, as well as lithics, animal bones, and daub fragments. The pit was identified at the base of the plowzone, and it appears truncated by the plowzone. However, a radiocarbon date from the feature suggests that it was filled during the earlier phase at Körösladány-Bikeri. It is possible that this discrepancy is the result of deeper plowing and/or erosion in this part of the site. Another shallow pit containing fish and mammal bones, and a moderate amount of Early Copper Age ceramics, was located midway between Features 28 and 29 (Feature 43; Figure 7.47); it was dug from the lower cultural layer into the paleosol.

Block 5

A 3 x 20 m slit trench was opened at the southern edge of the site in 2005 to examine the three, concentric, circular magnetic anomalies that encircle Körösladány-Bikeri (anomalies K1, K2, and K3; Figures 7.4B and 7.48; see also Chapter 6 and Figure 6.5, this volume). In 2006, a 6 x 7 m extension was added east of this trench.

Below the upper cultural layer, a narrow inner ditch (Feature 8/46), about 40 cm wide, was found. The segment of the ditch in the Block 5 extension was labeled Feature 46 when first encountered, but later it was determined that it also was part of the inner ditch (Figures 7.49–7.50). A total of 14 postholes (Features 17, 20 to

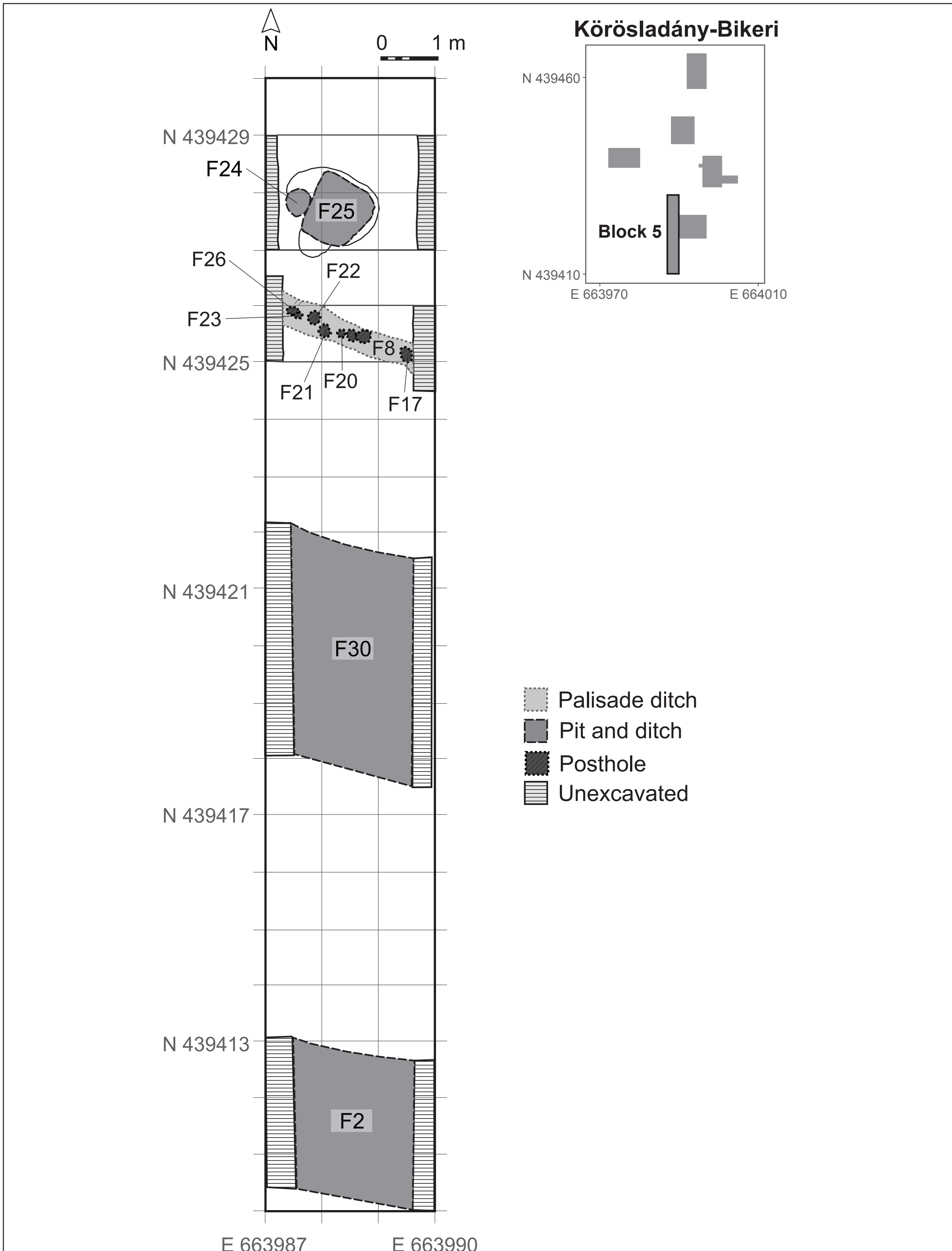


Figure 7.48. Plan map of Block 5 at Körösladány-Bikeri with features discussed in the text. *Figure by Jill Seagard.*

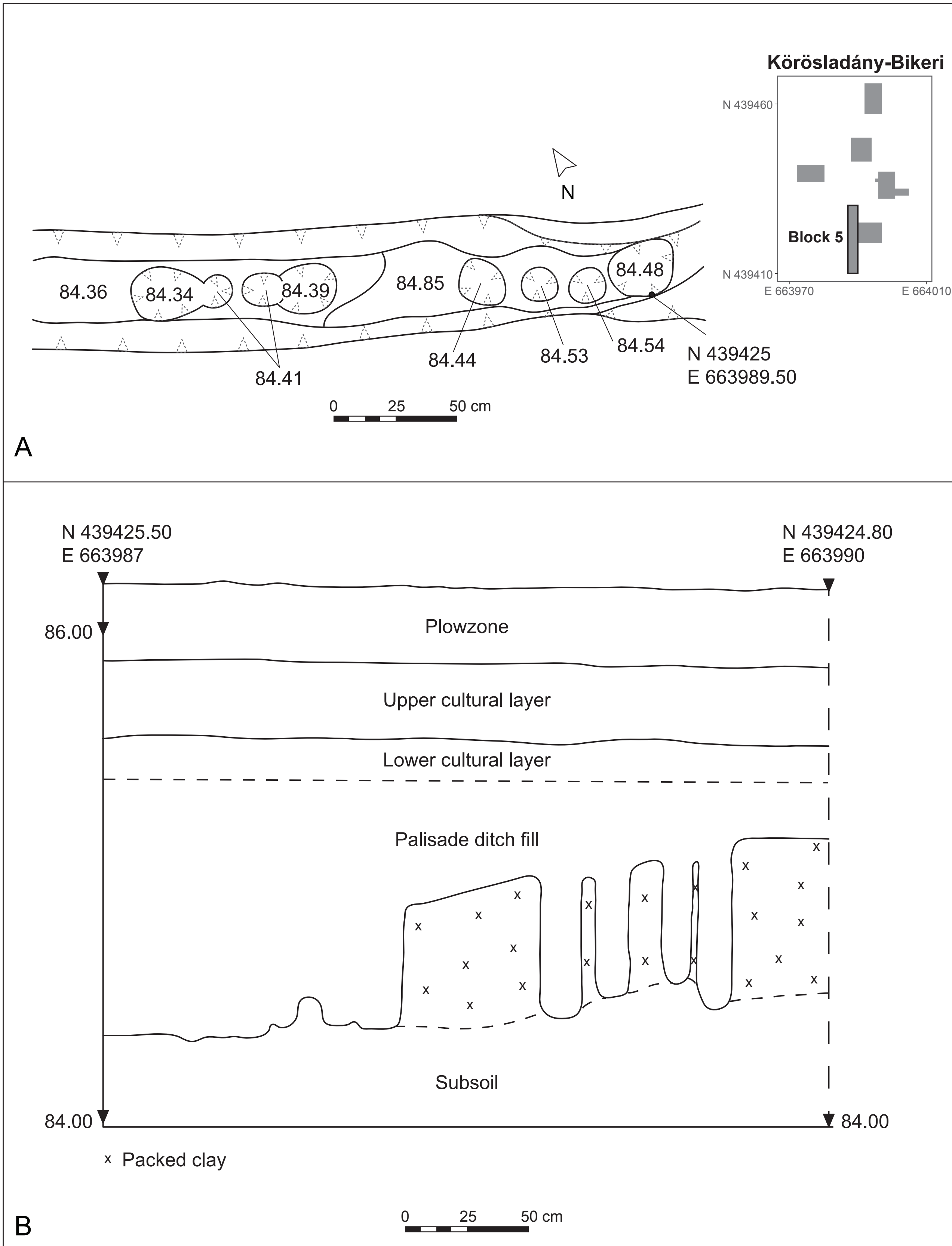


Figure 7.49. Feature 8 inner ditch in Block 5 at Körösladány-Bikeri. A: Plan map showing postholes; B: Profile drawing. *Figure by Jill Seagard and William A. Parkinson.*

Figure 7.50. Photograph of Feature 8 inner ditch in Block 5 at Körösladány-Bikeri. Facing northwest. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

23, and 26 in the original block and Features 50 to 57 in the extension) were excavated into the bottom of the ditch, indicating that the feature was a palisade similar to the one at Vésztő-Bikeri. Many posts were sunk 1.7 m below the modern ground surface, considerably deeper than the posts in the inner palisade ditch at Vésztő-Bikeri (Figure 7.50). Based on the stratigraphy, this inner palisade ditch seems to have been constructed during the earlier Early Copper Age occupation episode at Körösladány-Bikeri. The posts were removed and the palisade ditch was filled in later, and a cultural layer developed on top of this fill.

The middle ditch was located about 5 m outside the inner ditch, approximately the same distance that separated the inner and outer ditches at Vésztő-Bikeri (Feature 30; Figures 7.48 and 7.51). This ditch had a trapezoidal cross-section, was about 3.8 m wide, and extended about 2.2 m below the modern ground surface. Like the inner ditch, Feature 30 was covered with a cultural layer that represents the later occupation phase at the site, and therefore it was not visible when the plowzone was removed. Gleying in the loess subsoil at the base of the feature suggests that the middle ditch may have held water at one point, but it was cleaned out before it was filled in. A possible posthole just south of the ditch also was covered by the upper Early Copper Age cultural layer (Feature 31; see Figure 8.8).

A contracted subadult skeleton lying on its left side was found along with four Tiszapolgár ceramic vessels and scattered ocher around the body in the upper cultural layer about midway between the inner and the middle ditches (Feature 47; see Figure 8.9; see also Chapter 16, this volume). Like the other three infant burials excavated at the site (Features 1, 11, and 12), the burial pit was not visible.

A short segment of the outer ditch also was excavated in Block 5 (Feature 2; Figures 7.48, 7.52–7.55). This feature became visible immediately below the plowzone; thus it was constructed later than the inner and middle ditches. Feature 2 was located about 5 m outside the middle ditch and was 2–2.3 m wide. It extended 1.6–1.8 m below the modern surface, which is similar to the depth of the outer ditch at Vésztő-Bikeri, but Feature 2 at Körösladány-Bikeri was much wider. The cross-section was trapezoidal and the base was flat, with a series of 20 cm high and 1.3 m long steps. Several layers were identified in the feature fill (Figure 7.52), including a layer of dark meadow clay with very few artifacts at the top. It appears that the ditch was not filled to the top when the site was abandoned and that it held rainwater until it silted in and a meadow clay deposit formed in it.

Another small anomaly located just inside the palisade ditch turned out to be an intrusive Bronze Age pit. This oval-shaped deep pit was observed immediately below the plowzone and had a trapezoidal cross-section (Feature 25; Figure 7.48; see also Figure 8.10). It contained daub, animal remains, and Late Bronze Age ceramic sherds. A small feature also was exposed adjacent to this Late Bronze Age pit, but diagnostic material was not exposed from this pit (Feature 24; Figure 7.48; see also Figure 8.10).

Block 6

A 6 x 7 m block was opened in 2006 to explore the central area of the Early Copper Age settlement (Figures 7.4 and 7.56). The only feature exposed in this area was a circular bell-shaped pit that extended into the southern profile and cut through the cultural layers and the paleosol into the loess subsoil (Feature 35; Figure 7.56). A daub-like material with impressions of plant fibers that may have lined the pit was noted on one side of the feature. The fill contained four stratigraphic layers representing distinct fill episodes. Large numbers of Tiszapolgár ceramics, animal bones, fish bones and scales, shells, lithics, and a grinding

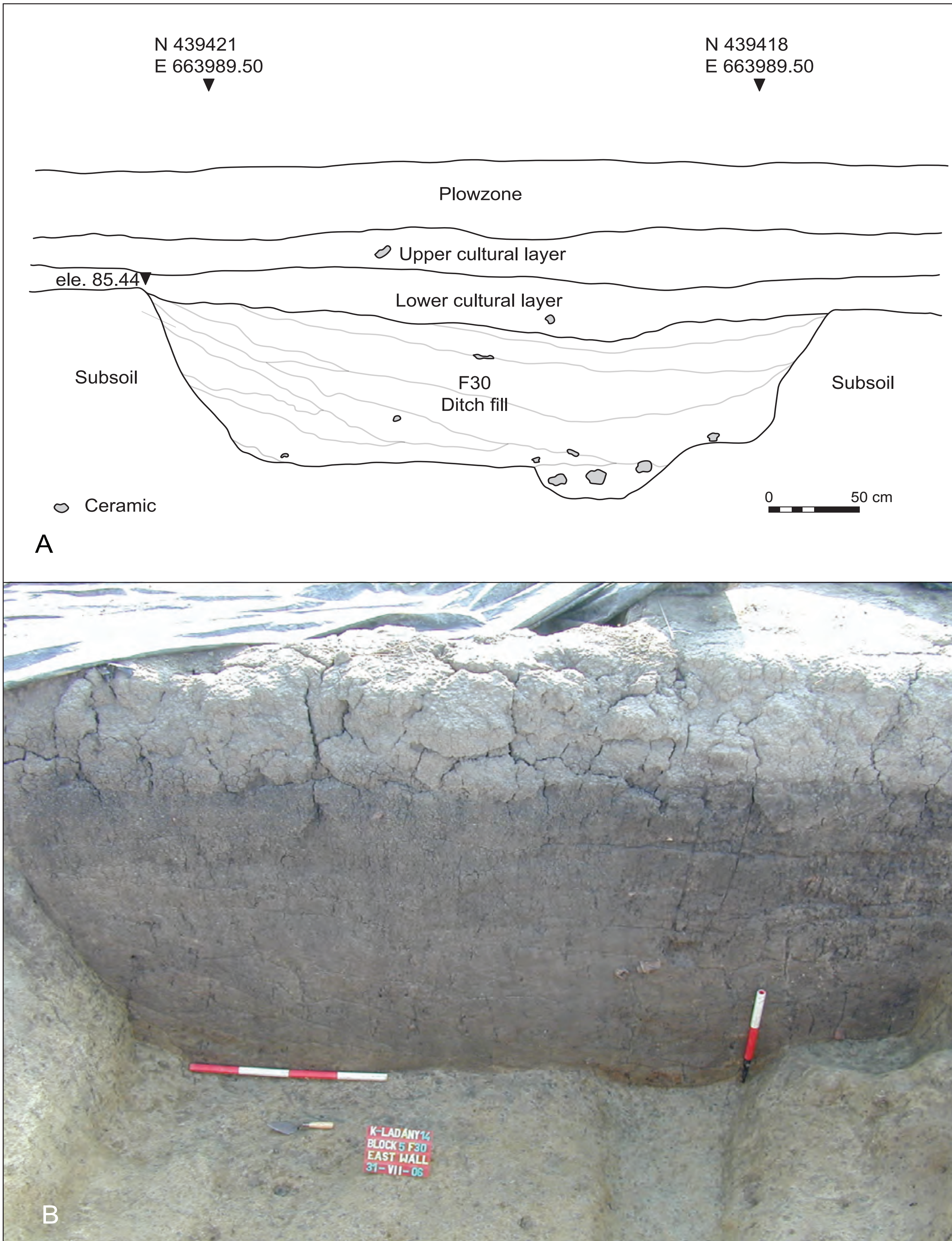


Figure 7.51. Feature 30 middle ditch in Block 5 at Körösladány-Bikeri. A: Profile map; B: Photograph. Facing east. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

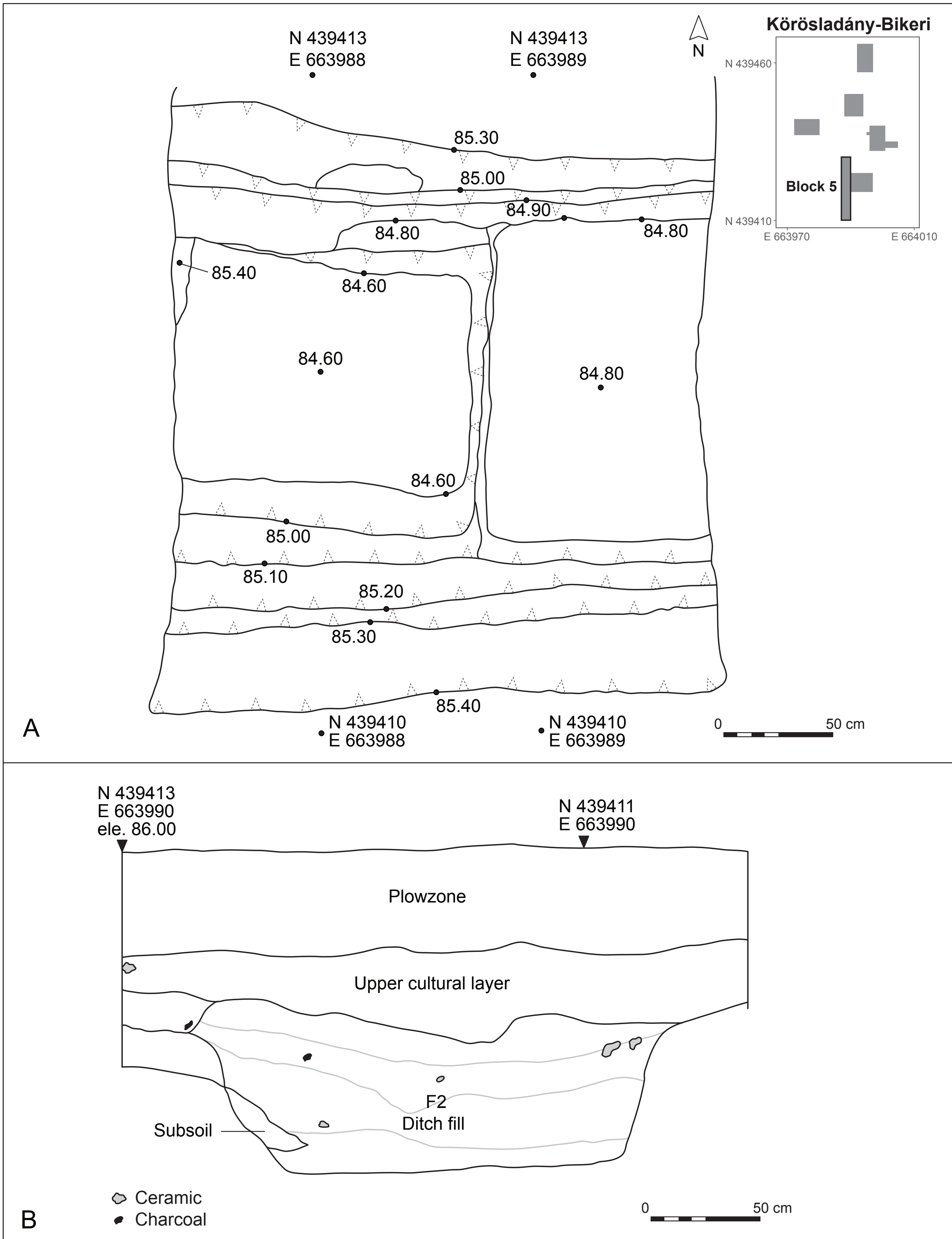


Figure 7.52. Feature 2 outer ditch in Block 5 at Körösladány-Bikeri. A: Plan map; B: Profile drawing. *Figure by Jill Seagard and William A. Parkinson.*

Figure 7.53. Photograph of Feature 2 outer ditch in Block 5 at Körösladány-Bikeri. Facing northeast. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Figure 7.54. Photograph of Feature 2 outer ditch in Block 5 at Körösladány-Bikeri. Facing northwest. Scale bar indicates 20 cm units. *Figure by William A. Parkinson.*

Figure 7.55. Photograph of Feature 2 outer ditch in Block 5 at Körösladány-Bikeri. Facing south. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

stone were recovered from the feature. A nearly complete jar was found in the southern profile. Like Feature 10 in Block 4, the pit seems to have been reused as a garbage pit after it was used as a storage pit.

Block 7

A 5 x 8 m block was laid out in the western periphery of the site in 2006 to investigate some large, circular anomalies identified during the magnetic survey (Figure 7.4B; see also Chapter 6 and Figure 6.5, this volume).

A 1 m long section of the inner enclosure ditch was exposed in the southwestern corner of the excavation block (Feature 8/46; Figure 7.57A). It was filled in and covered with the upper cultural layer. The eastern half of a large and deep pit also was excavated in the center of the block (Feature 49; Figure 7.57). Feature 49 contained Early Copper Age ceramics, animal bones, shells, and lithics. Both features are associated with the earlier occupation phase.

Immediately below the plowzone, in the eastern part of the block, a well was exposed (Feature 48; Figures 7.57A, 7.58–7.60). The upper part of the feature was oval and about 1.60 x 1.85 m in diameter at the top, while the bottom 1–1.3 m were cut as a square into the subsoil. This lower section measured about 1 x 1 m. Because of groundwater, our excavation extended only to about 1.7 m from the modern surface. Hand cores indicated that the total depth of the well measured 2.4–2.9 m from the current ground level (the northern section of the base was higher) and 2.2–2.5 m from the level where the feature was first identified. Decomposed remains of a wooden construction were observed in the upper portion of the well, while in the lower part, wood remains and impressions of wooden planks were documented along the interior walls. The coring results indicated the presence of an ash layer and additional wood remains below the groundwater level. Several fill layers were exposed during our excavation. Tiszapolgár ceramics, grinding stones, lithics, daub, mammal and fish bones, fish scales, shell, and a copper ring fragment were found in distinct clusters within the compact fill of the cylindrical upper section of the shaft. The lower, squared part had an ashy, wet fill with a large amount of charcoal and wood remains as well as a large number of daub and ceramics. The ceramic assemblage from the well includes multiple types of complete and partial vessels, most of which were found in two clusters in one of the ashy layers (see Chapter 9, this volume).

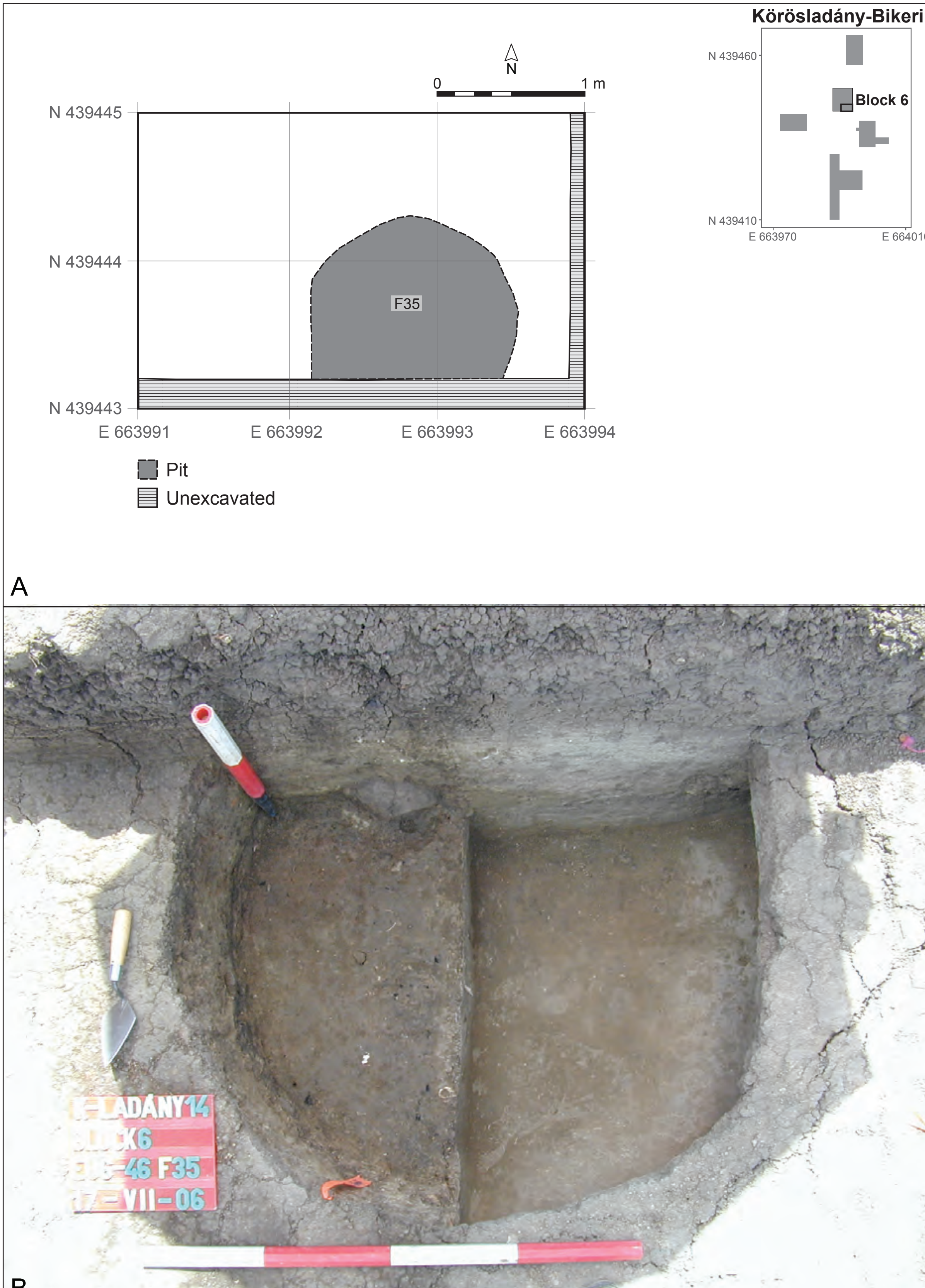


Figure 7.56. Feature 35 pit in Block 6 at Körösladány-Bikeri. A: Plan map; B: Photograph during excavation. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

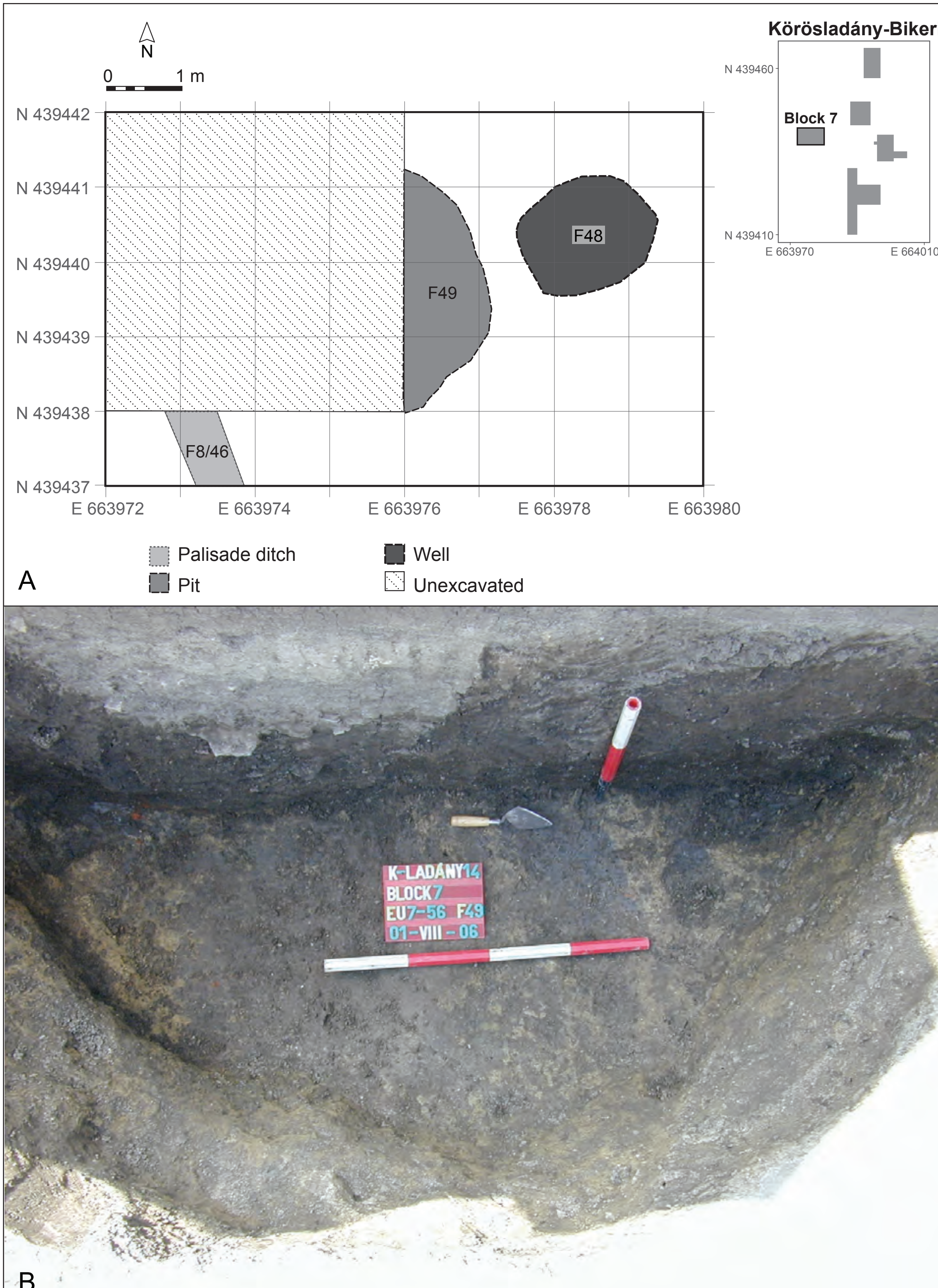


Figure 7.57. A: Plan map of Block 7 showing features discussed in text; B: Photograph of Feature 49 pit. Trowel points north. Scale bars indicate 20 cm units. *Figure by Jill Seagard and William A. Parkinson.*

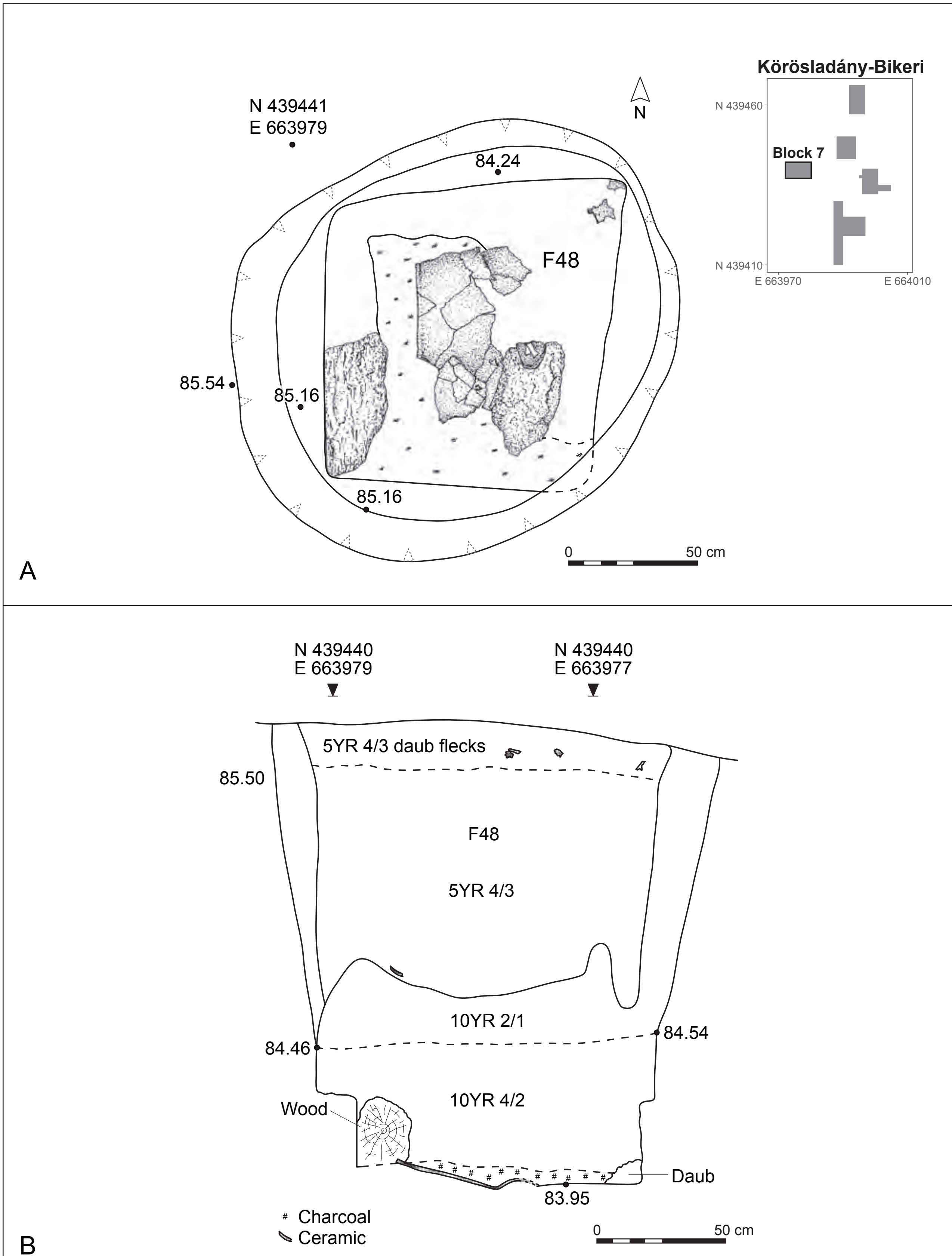


Figure 7.58. Feature 48 well in Block 7 at Körösladány-Bikeri. A: Plan map showing preserved wood (left) ceramics (center) and daub at bottom of well; B: Profile map. *Figure by Dorottya Kékegyi and Jill Seagard.*

Figure 7.59. Photograph of Feature 48 well in Block 7 at Körösladány-Bikeri during excavation. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Figure 7.60. Photograph of Feature 48 well in Block 7 at Körösladány-Bikeri during excavation. Trowel points north. Scale bars indicate 20 cm units. *Figure by William A. Parkinson.*

Conclusions

By using micro-stratigraphic excavation methods at the Vésztő-Bikeri and Körösladány-Bikeri sites, we were able to explore the development of these Early Copper Age villages. We excavated a total of 500 m^2 or 11.4 percent of the Vésztő-Bikeri site and 286 m^2 or 7.5 percent of the Körösladány-Bikeri settlement. We exposed large rectangular longhouse structures, pits, wells or cisterns, external kilns or ovens, burials, and systems of large palisades and V-shaped and trapezoidal ditches that enclosed the settlements. We were able to collect and compare cultural and biological materials from these features and from other depositional contexts, such as the middens within the sites and the cultural deposits that were mounded over the center of the settlements. The excavations confirmed multiple settlement episodes at both villages and indicate longer periods of occupations as opposed to the previously suggested ephemeral Tiszapolgár settlements on the Great Hungarian Plain. The results allow us to conclude how the organization of small Early Copper Age settlements differed from nucleated Late Neolithic villages in the region. We also were able to track changes in settlement practices over time within these adjacent, fortified Tiszapolgár sites (see Chapter 8, this volume).

Chapter 8

Settlement Chronology and Layout

Attila Gyucha, Richard W. Yerkes, and William A. Parkinson

Multidisciplinary investigations at the Early Copper Age sites of Vésztő-Bikeri and Körösladány-Bikeri, including remote sensing, chemical survey, gridded surface collection, and excavations, exposed the layout and internal organization of the two villages. Stratigraphic observations of and absolute dates from excavated contexts permit us to make inferences about the chronological and spatial development of these sites. In this chapter, we synthesize the relative and absolute chronological information from Vésztő-Bikeri and Körösladány-Bikeri, outline major transformations in site layout and use, and discuss our results within the broader context of the Great Hungarian Plain.

Settlement Chronology and Layout at Vésztő-Bikeri

Bayesian and contextual analyses of radiocarbon dates collected from Vésztő-Bikeri indicate three temporal phases in the use of the site during the Early Copper Age (Table 8.1). In addition, the combined data from geophysical prospection, soil chemistry, and excavations provide us a relatively clear pattern of layout. Figure 8.1 shows a schematic representation of contemporaneous excavated features in use at the site at different times during the second half of the fifth millennium BC.

The First Early Copper Age Phase at Vésztő-Bikeri

Three radiocarbon dates represent the First Early Copper Age Phase of the Vésztő-Bikeri site: one from Structure A1 and two from deposits on or in the floor level of the Feature 4/14 longhouse (Table 8.1; Figure 8.2). These latter two dates are attributed to redeposition and leveling activities that occurred at the site before and during the Second Early Copper Age Phase (see below). Results of a T-test show that the three older dates are statistically the same at the 95 percent level ($T = 1.60$, critical value $= 5.99$, $df = 2$, 0.05 level). The range for the summed probabilities (1σ) for this early group of dates is 4608–4453 cal BC, with a median of 4530.5 cal BC.

The base of the stratigraphic sequence at Vésztő-Bikeri is a buried soil horizon, 15–20 cm in thickness, that formed above the redeposited loess subsoil. The top of this paleosol was the ancient ground surface during the initial occupation of the site by Early Copper Age farmers. Although we do not have a radiocarbon date from the Feature 150 pit in Block 9, this feature was dug from the top of the paleosol and likely represents the earliest Early Copper Age activities we were able to identify at the site (Figures 8.1A and 8.3).

Anthropogenic sediments measuring 20–30 cm in thickness accumulated above this buried soil. This lower cultural layer was thickest in the center and thinned out

Table 8.1. Radiocarbon dates from Vésztő-Bikeri and Körösladány-Bikeri

Sample	Site	Block	Context	Feature	Feature Description	Method	Conventional BP
Vésztő-Bikeri	**First Early Copper Age Phase**						
Beta-162066	Vésztő-Bikeri	2	EU 2-18	F4	Floor level	AMS	5660
Beta-162065	Vésztő-Bikeri	1	EU 1-13	F2	Circular pit	AMS	5700
Beta-162069	Vésztő-Bikeri	2	EU 2-37	F4	Floor level	AMS	5790
Summed Probabilities (1 sigma)							
Vésztő-Bikeri	**Second Early Copper Age Phase**						
Beta-179793	Vésztő-Bikeri	6	EU 6-4	F21	Middle ditch	AMS	5420
Beta-179792	Vésztő-Bikeri	6	EU 6-6	F20	Inner ditch	AMS	5440
Beta-179787	Vésztő-Bikeri	2	EU 2-310	F28	N–S wall trench between F4 and F15	Conventional radiometric/ Extended count	5440
Beta-179789	Vésztő-Bikeri	2	EU 2-347	F26	E–W wall trench of F4/14	AMS	5460
Beta-214593	Vésztő-Bikeri	9	EU 9-101	F15	N wall trench of F15	AMS	5480
Beta-162068	Vésztő-Bikeri	2	EU 2-37	F4	Floor level	AMS	5480
Beta-162070	Vésztő-Bikeri	3	EU 3-4	F5	Base of plowzone	AMS	5490
Beta-179783	Vésztő-Bikeri	2	EU 2-234	F14	Base of plowzone	Conventional radiometric	5520
Beta-179788	Vésztő-Bikeri	2	EU 2-337	F26	E–W wall trench of F4/14	AMS	5540
Beta-179786	Vésztő-Bikeri	2	EU 2-284	F28	N–S wall trench between F4 and F15	Conventional radiometric/ Extended count	5540
Beta-179790	Vésztő-Bikeri	5	EU 5-3	F19	Outer ditch	AMS	5550
Beta-179785	Vésztő-Bikeri	2	EU 2-271	F13	Bell-shaped pit	AMS	5560
Beta-179784	Vésztő-Bikeri	2	EU 2-251	F13	Bell-shaped pit	AMS	5580
Beta-214589	Vésztő-Bikeri	7	EU 7-58	F71	Burial	AMS	5610
Beta-179791	Vésztő-Bikeri	5	EU 5-6	F27	Inner ditch posthole	AMS	5620
Summed Probabilities (1 sigma)							
Vésztő-Bikeri	**Third Early Copper Age Phase**						
Beta-179782	Vésztő-Bikeri	2	EU 2-223	F14	Daub layer in F4/14	Conventional radiometric	5310
Beta-162067	Vésztő-Bikeri	2	EU 2-27	F4	Daub layer above floor	AMS	5320
Beta-214592	Vésztő-Bikeri	8	EU 8-34	F35	Kiln or oven	AMS	5410
Beta-162071	Vésztő-Bikeri	4	EU 4-3	Midden	Base of plowzone	AMS	5430
Summed Probabilities (1 sigma)							
Vésztő-Bikeri	**Árpádian Age**						
Beta-214594	Vésztő-Bikeri	9	EU 9-80		Upper cultural layer	AMS	780

Dev	Calibrated (1 sigma) BC		% Under Curve												
40	4536	4456	*100%*												
40	4584	4487	*92%*	4476	4465	*8%*									
100	4730	4526	*92%*	4769	4756	*5%*	4744	4733	*3%*						
	4608	***4453***	***100%***												
50	4335	4244	*100%*												
50	4342	4259	*100%*												
140	4374	4223	*55%*	4132	4064	*19%*	4208	4155	*15%*	4446	4419	*7%*	4399	4381	*4%*
50	4353	4313	*51%*	4301	4260	*49%*									
50	4366	4315	*64%*	4299	4261	36%									
40	4360	4322	*70%*	4289	4267	*30%*									
50	4370	4321	*65%*	4293	4265	*25%*	4441	4424	*10%*						
50	4374	4334	*55%*	4446	4419	*28%*	4399	4381	*17%*						
40	4374	4345	*44%*	4446	4420	*36%*	4398	4382	*20%*						
60	4405	4342	*65%*	4448	4415	*35%*									
40	4446	4419	*39%*	4375	4351	*34%*	4400	4379	*27%*						
50	4405	4355	*60%*	4448	4415	*40%*									
50	4452	4364	*100%*												
40	4426	4360	*61%*	4464	4438	*30%*	4487	4476	*9%*						
40	4493	4444	*55%*	4422	4372	*45%*									
	4451	***4325***	***91%***	***4286***	***4270***	***9%***									
50	4138	4052	*56%*	4231	4194	*24%*	4176	4144	*20%*						
60	4235	4146	*51%*	4136	4053	*49%*									
40	4329	4251	*99%*	4246	4246	*1%*									
40	4304	4259	*65%*	4336	4311	*35%*									
	4338	***4227***	***76%***	***4202***	***4168***	***14%***	***4096***	***4078***	***7%***	***4127***	***4118***	***3%***			
40	1223	1270	100%												

Table 8.1. Radiocarbon dates from Vésztő-Bikeri and Körösladány-Bikeri *(continued)*

Sample	Site	Block	Context	Feature	Feature Description	Method	Conventional BP
Körösladány-Bikeri	**First Early Copper Age Phase**						
Beta-234307	Körösladány-Bikeri	4	EU 4-138	F28	Bell-shaped pit	AMS	5520
Beta-234308	Körösladány-Bikeri	4	EU 4-143	F29	Wall trench	AMS	5560
Beta-234310	Körösladány-Bikeri	5	EU 5-124	F30	Middle ditch	AMS	5730
Beta-214597	Körösladány-Bikeri	5	EU 5-48	F8/9	Inner ditch posthole	AMS	5740
Summed Probabilities (1 sigma)							
Körösladány-Bikeri	**Second Early Copper Age Phase**						
Beta-214596	Körösladány-Bikeri	5	EU 5-53	F2	Outer ditch	AMS	5370
Beta-234313	Körösladány-Bikeri	7	EU 7-64	F48	Well, sample 1	Conventional radiometric	5370
Beta-234312	Körösladány-Bikeri	6	EU 6-46	F35	Bell-shaped pit	AMS	5380
Beta-234306	Körösladány-Bikeri	4	EU 4-103	F10	Bell-shaped pit	Conventional radiometric	5410
Beta-214595	Körösladány-Bikeri	4	EU 4-48	F5	Bell-shaped pit	AMS	5420
Beta-234314	Körösladány-Bikeri	7	EU 7-64	F48	Well, sample 2	Conventional radiometric	5430
Summed Probabilities (1 sigma)							

toward the periphery of the village. It may have developed as a result of residential activities during the First Early Copper Age Phase, but sediments also may have been intentionally redeposited during the initial establishment of the settlement. The presence of Early Copper Age artifacts in this lower layer and the stratigraphic position of a ditch section in Block 9 (Feature 127; Figures 8.1A and 8.3), which originated in this layer, indicate that if sediments were intentionally redeposited, this was preceded by at least some other activities at the site. The moderate amount of artifacts recovered from the lower cultural layer, relative to the upper cultural layer, suggests less intensive occupation at Vésztő-Bikeri during this early stage.

Clay and silt that may have been used for building up the site could have derived from the enclosure ditches and palisade, as well as from other features, such as the well in Block 8 (Feature 151; Figures 8.1A and 8.3). These sediments may have been intentionally redeposited to artificially raise the elevation of the low rise where the site is located or to create a platform for structures in the center. The radiocarbon dates associated with the enclosure are from the time when the palisade was taken down and the ditches were filled in; they do not date the initial excavation of the ditches (Table 8.1; Figure 8.2). Based on stratigraphic relationships, however, it seems the ditch-palisade system was constructed sometime during the First Early Copper Age Phase at Vésztő-Bikeri. The structure of the ditch-palisade system, with a wide outer ditch, a wattle-and-daub palisade, and an interior wooden platform supported by large posts, led us to suggest that it served a defensive purpose (Figures 8.1A and 8.3; see also Keeley et al. 2007; Parkinson and Duffy 2007). However, the enclosure system also may have served other purposes related to water and animal management. Based upon the magnetic survey and our excavations, the outer ditch measured about 75 m in diameter, enclosing an area of approximately 0.44 ha, and the diameter of the palisade was about 65 m, encircling an area of about 0.33 ha.

Both direct and indirect evidence is available for domestic structures where the founding members of the Vésztő-Bikeri community may have lived (Figure 8.1A). The large amounts of burned daub pieces unearthed in

Dev	Calibrated (1 sigma) BC		% Under Curve												
40	4373	4335	*65%*	4444	4421	*28%*	4394	4386	*7%*						
40	4402	4357	*60%*	4447	4418	*40%*									
40	4617	4514	*89%*	4652	4641	*7%*	4510	4504	*4%*						
40	4619	4536	*75%*	4655	4637	*13%*	4678	4658	*12%*						
	4449	***4338***	***65%***	***4611***	***4538***	***35%***									
40	4268	4228	*36%*	4325	4287	*29%*	4201	4169	*23%*	4094	4079	*8%*	4127	4120	*4%*
60	4271	4226	*29%*	4327	4282	*27%*	4204	4165	*22%*	4100	4074	*14%*	4129	4114	*8%*
40	4274	4229	*42%*	4328	4280	*41%*	4197	4172	*17%*	4087	4085	*<1%*			
80	4347	4227	*74%*	4202	4168	*15%*	4097	4077	*8%*	4128	4118	*3%*			
40	4332	4258	*100%*												
50	4339	4253	*100%*												
	4337	***4230***	***89%***	***4196***	***4174***	***11%***									

secondary contexts in the wall trenches of Feature 15 in Block 9 are indicative of burned wattle-and-daub dwellings in the First Early Copper Age Phase at Vésztő-Bikeri. In addition, a radiocarbon date from Structure A1 in Block 1 (Figures 8.1A and 8.3) suggests that this building was the oldest structure we excavated at the site. A sample from the fill of a pit or large posthole (Feature 2) associated with Structure A1 had a calibrated range (1σ) of 4584–4465 cal BC (median = 4524.5 cal BC; see Table 8.1; Figure 8.2). This date and two other dates on redeposited materials from and near the floor level of Feature 4/14 (Table 8.1; Figure 8.2) fall at the very beginning of the Early Copper Age Tiszapolgár period, a time when nearby Late Neolithic and Proto-Tiszapolgár settlements were still inhabited (Yerkes et al. 2009).

The Second Early Copper Age Phase at Vésztő-Bikeri

The majority of our excavations took place within the upper cultural layer at Vésztő-Bikeri. As a result, the majority of radiocarbon dates represent the younger (later) phases at the site. The group of 15 calibrated dates for the Second Early Copper Age Phase at Vésztő-Bikeri came from 10 different depositional contexts (Table 8.1; Figure 8.2). The summed probabilities for these 15 dates (1σ) range from 4451 to 4270 cal BC, and Bayesian modeling puts the starting boundary of the Second Early Copper Age Phase between 4407 and 4356 cal BC (mean = 4395 cal BC) and the ending boundary between 4349 and 4314 cal BC (mean = 4322 cal BC).

These dates suggest that by 4450 cal BC, all the elements of the enclosure system, including the large circular ditches, the palisade, and the interior wooden platform, already had been constructed at Vésztő-Bikeri (Figure 8.1B). In fact, an adult burial in Block 7 (Feature 71; Figure 8.4) that was placed in one of the filled-in postholes (Feature 74) of the platform also dates to this Second Early Copper Age Phase, indicating that the platform was dismantled, or perhaps reconstructed, during this stage (Figure 8.1C).

The radiocarbon dates also permit us to associate several longhouses with the Second Early Copper Age Phase at Vésztő-Bikeri (Figures 8.1B and 8.4). These

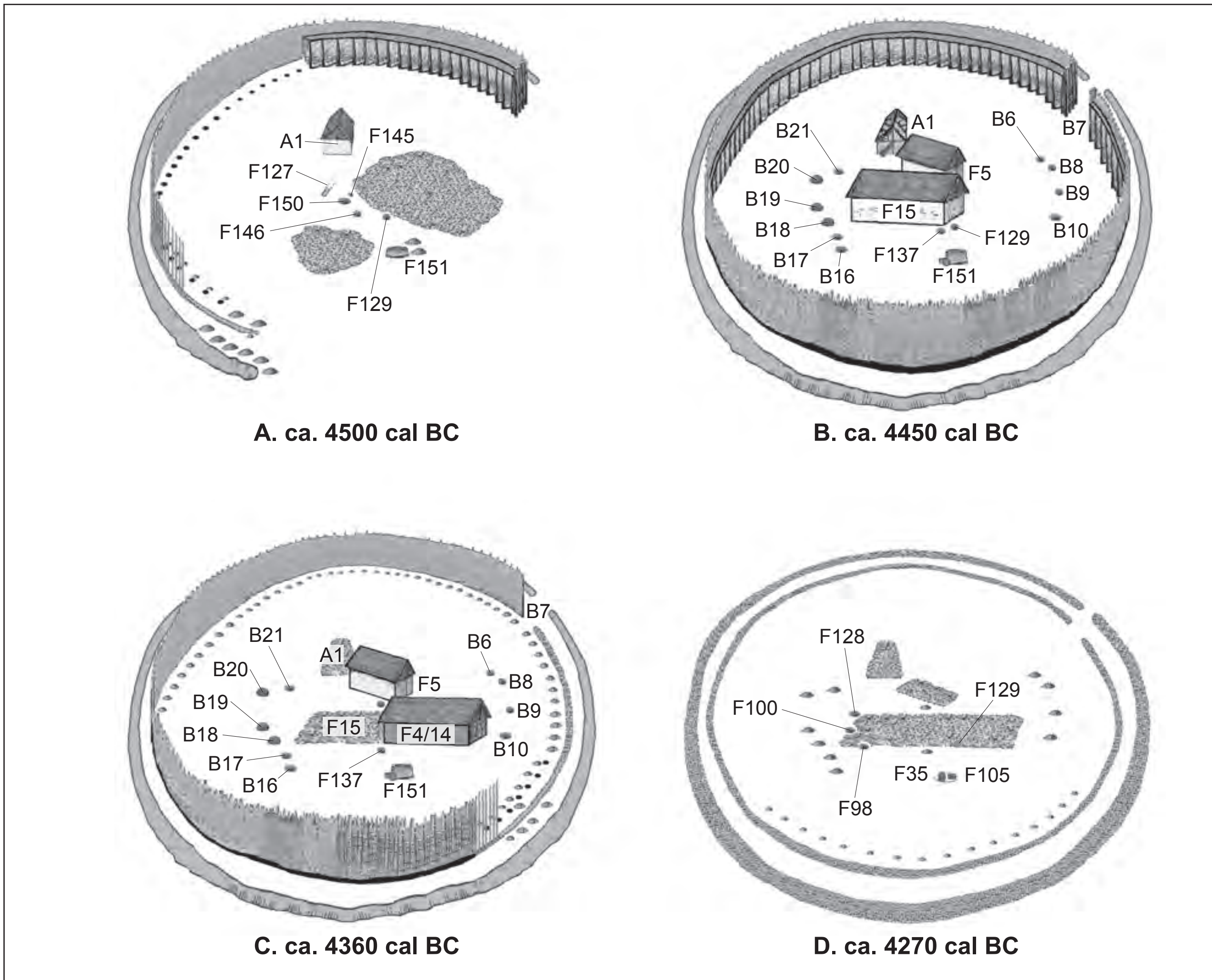


Figure 8.1. Schematic reconstructions of Vésztő-Bikeri during different Early Copper Age phases. A: First Early Copper Age Phase, circa 4500 cal BC; B: Second Early Copper Age Phase, circa 4450 cal BC; C: Second Early Copper Age Phase, circa 4360 cal BC; D: Third Early Copper Age Phase, circa 4270 cal BC. *Figure by Richard W. Yerkes and Jill Seagard.*

structures were clustered in the center of the village, and their wall trenches were dug through the lower cultural layer, through the buried soil, and into the sterile subsoil. Some of the linear magnetic anomalies in the eastern and southern parts of the site that were not subject to excavations, including A6, A7, A10, and A11 (see Figure 6.3), also may be interpreted as sections of wall trenches associated with other structures.

Our excavations revealed that not all the buildings associated with this Second Early Copper Age Phase were occupied at the same time, and there were multiple rebuilding episodes. Structure A1 may have been dismantled and abandoned at the beginning of this phase, and two of the longhouses, Features 15 and 4/14 excavated in Blocks 2 and 9, were built around this time (Figures 8.1B–C and 8.4). Both Features 15 and 4/14 were oriented east–west and shared a common wall trench. Feature 15, a *pisé de terre* building, was the older of these two large central structures. Sometime before the end of the Second Early Copper Age Phase, Feature 15 was deliberately dismantled and its eastern wall was used as the western wall of Feature 4/14 (Figures 8.1C and 8.4). The other walls were built of a wood post-and-wattle framework that was covered with daub.

We partially excavated another structure in Block 3 (Feature 5) in the center of the Vésztő-Bikeri site that also seems to have been built during the Second Early Copper Age Phase. Similar to Feature 4/14, this house burned

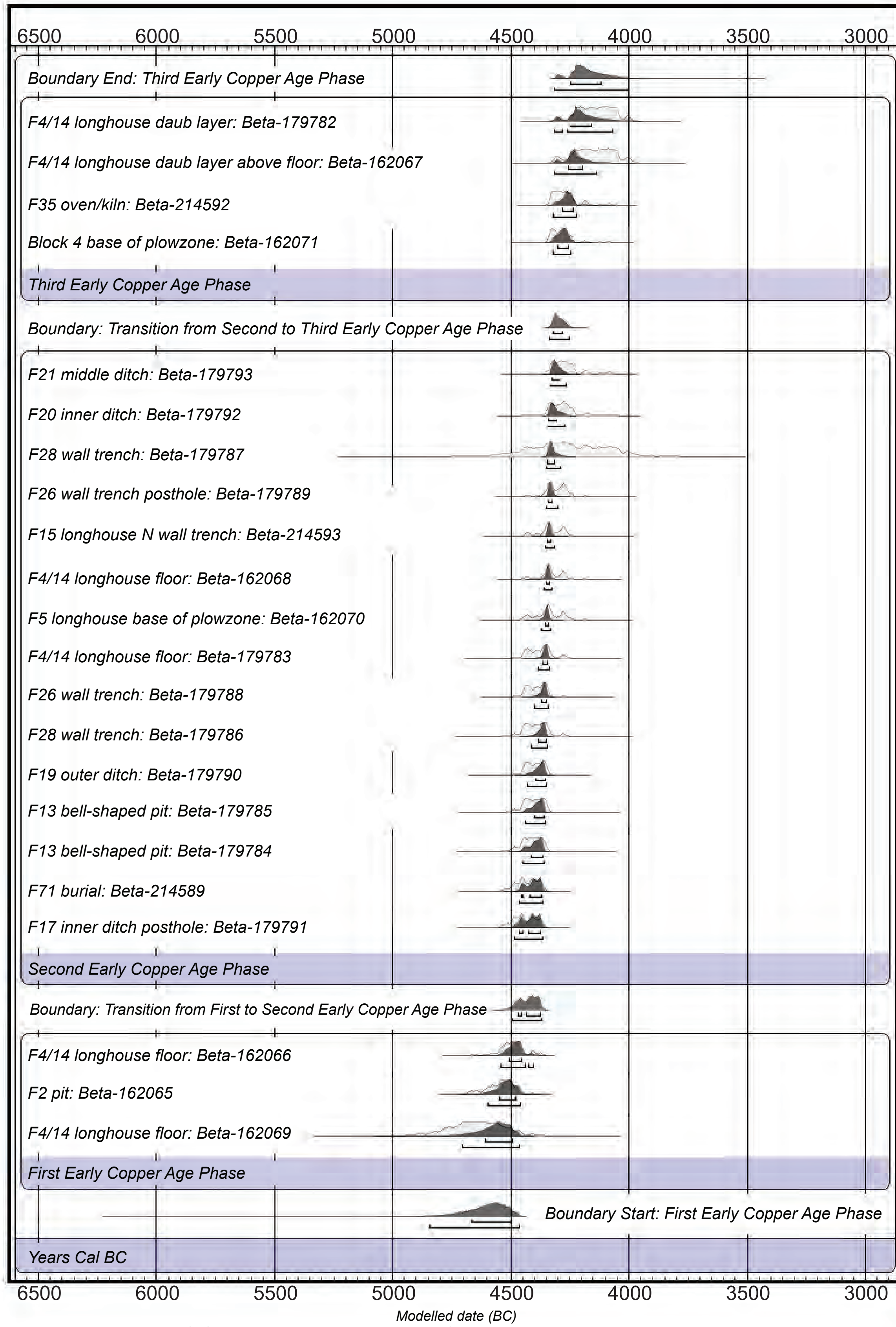


Figure 8.2. Calibrated radiocarbon dates from Vésztő-Bikeri. *Figure by Richard W. Yerkes and Jill Seagard.*

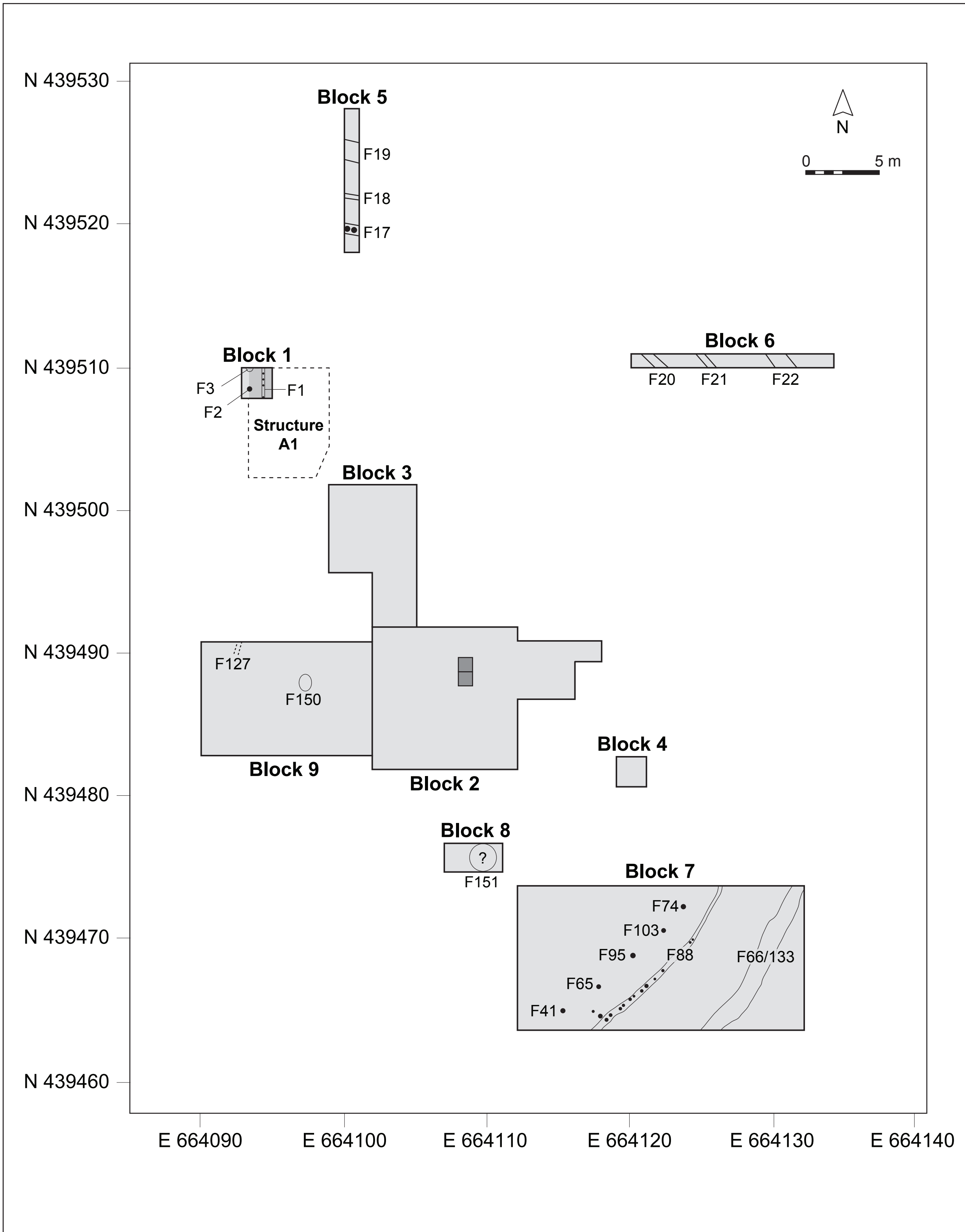


Figure 8.3. First Early Copper Age Phase features and excavated contexts at Vésztő-Bikeri based on calibrated radiocarbon dates and stratigraphy. Excavated areas are light shaded. Features and excavation units (small squares) that contained radiocarbon samples are dark shaded. Black dots are postholes; open circles are pits. *Figure by Richard W. Yerkes and Jill Seagard.*

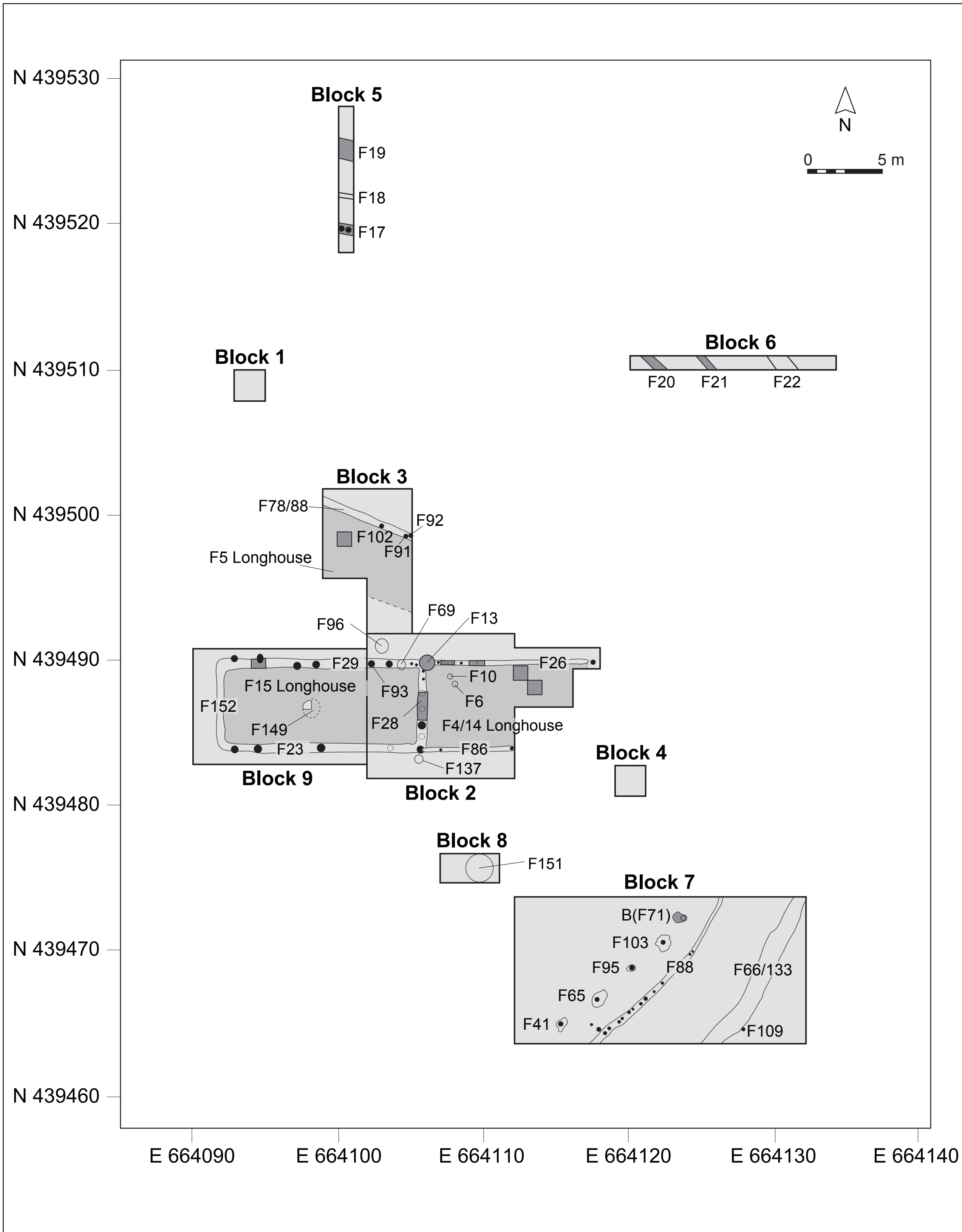


Figure 8.4. Second Early Copper Age Phase features and excavated contexts at Vésztő-Bikeri based on calibrated radiocarbon dates and stratigraphy. Excavated areas are light shaded. Features and excavation units (small squares) that contained radiocarbon samples are dark shaded. Lighter shaded areas are floors of longhouses. Black dots are postholes; open circles are pits. *Figure by Richard W. Yerkes and Jill Seagard.*

down and the rubble from the collapsed and knocked-down walls preserved a large amount of in situ artifacts on the floor level. In contrast to Features 15 and 4/14, the exposed wall trench (Feature 78) indicates that this structure was oriented northwest–southeast (Figures 8.1B–C and 8.4). The chronological relationship between Feature 5 and Features 15 and 4/14 remains unclear.

Around the central longhouses, the excavations and geophysical prospection revealed a variety of different features (Figures 8.1B–C and 8.4). The magnetic anomalies indicate kilns, hearths, and storage/refuse pits in this area (see Figure 6.3). Feature 151 is a well or cistern located immediately southeast of the central longhouses (Figures 8.1B and 8.4). Between these features and the fortification, within a concentric zone of 7 to 12 m in width, the geophysical prospection did not identify features (see Figure 6.3). Our excavations in Block 4 produced a massive amount of animal bones in the cultural layer (see Chapter 14, this volume), indicating a ring midden, and the soil chemistry survey suggested that the livestock of the community might have been kept in this area, especially near the enclosure (see also Chapter 5, this volume).

It appears that around 4270 cal BC, the circular palisade and enclosure platform were completely dismantled, the ditches were filled in (at least in part), and a mantle of cultural material might have been deposited above the abandoned longhouses (Figure 8.1D). This mantle is part of the 20–40 cm–thick upper cultural layer at Vésztő-Bikeri. The Feature 151 well or cistern also was packed with fragments of heavily burned daub from wall rubble, possibly from Feature 4/14 or other structures, most likely at the end of the Second Early Copper Age Phase.

The uppermost portion of the cultural sequence at the site was truncated by plowing. The plowzone is typically 25–35 cm thick across the site, with some sections more than 40 cm thick, and contains abundant but disturbed Early Copper Age cultural material.

The Third Early Copper Age Phase at Vésztő-Bikeri

Four Early Copper Age radiocarbon dates from Vésztő-Bikeri are later than the 15 dates from the Second Early Copper Age Phase (Table 8.1; Figure 8.2). Summed probabilities (1σ) for these four dates range from 4335 to 4079 cal BC (median = 4207 cal BC). Bayesian modeling puts the starting boundary for these younger dates between 4377 and 4254 cal BC (mean = 4357 cal BC) and the ending boundary between 4256 and 4048 cal BC (mean = 4113 cal BC). These later dates may be on charred materials from the ring midden that later were incorporated into the mantle that covered the longhouses.

In contrast to the First and Second Early Copper Age Phases, the Third Early Copper Age Phase at Vésztő-Bikeri is not associated with residential activities at the site. No longhouses or other features that can be interpreted as domestic structures date to this phase. Instead, several pits were exposed in the central area during our excavations (Figures 8.1D and 8.5). These pits, such as Features 98, 100, and 128 in Block 9, and 129 in Block 2, were intrusive into the upper cultural mantle over the Features 15 and 4/14 longhouses. The radiocarbon dates suggest that refuse was still being deposited in the ring midden, and the two kilns or ovens exposed in Block 8 (Features 35 and 105) and constructed in the filled-in well or cistern (Feature 151) were in use during the Third Early Copper Age Phase. The stratigraphic position of an infant skeleton associated with Tiszapolgár grave goods from Block 3 (Feature 85) as well as additional, scattered human remains from the site (see Chapter 16, this volume) indicate that some burials, particularly subadults, may have been interred at Vésztő-Bikeri during this later phase. Taking the radiocarbon dates from Körösladány-Bikeri into consideration (see below), it is likely that the inhabitants of Vésztő-Bikeri who relocated their settlement to the adjacent Körösladány-Bikeri were responsible for these activities.

Other Prehistoric and Historic Use of Vésztő-Bikeri

Based on a few ceramics found primarily on the surface and in the plowzone, some activities occurred at the site during the Early Neolithic (Körös culture; circa 6000–5500 cal BC) and the Late Bronze Age (Gáva culture; circa 1300–900 cal BC). The two Hungarian Conquest period burials in Block 2 (Features 11 and 108; see Chapter 16, this volume, and Lichtenstein 2004) indicate that a small cemetery was established at the site in the tenth century AD. In addition, a single radiocarbon date on charred materials found just below the base of the plowzone in Block 9, outside the Feature 15 longhouse, yielded a calibrated date of AD 1190–1290 (Table 8.1), which falls within the Árpádian Age (eleventh to thirteenth century AD). A few Árpádian Age and medieval (fourteenth to seventeenth century AD) ceramics also were found on the surface and in the plowzone during our excavations (see Chapter 4, this volume), but, similar to the Early Neolithic and Late Bronze Age, no features from these periods were identified during our excavations at Vésztő-Bikeri. A pig skeleton exposed in Block 9 dates to the late medieval age or more recent times.

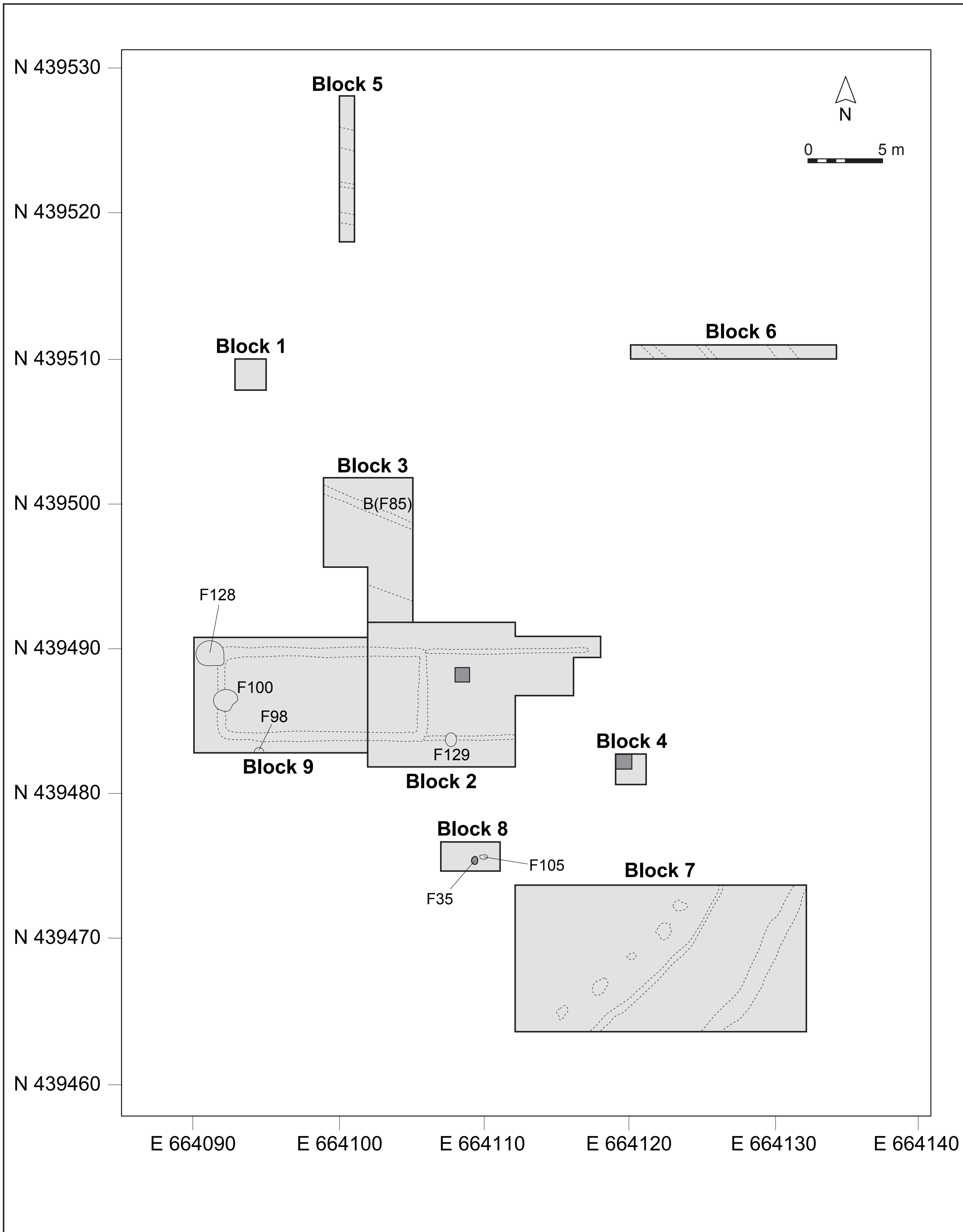


Figure 8.5. Third Early Copper Age Phase features and excavated contexts at Vésztő-Bikeri based on calibrated radiocarbon dates and stratigraphy. Excavated areas are light shaded. Features and excavation units (small squares) that contained radiocarbon samples are dark shaded. Open circles are pits. *Figure by Richard W. Yerkes and Jill Seagard.*

Settlement Chronology and Layout at Körösladány-Bikeri

Unlike Vésztő-Bikeri, which is essentially a single-component Early Copper Age site, surface collections suggested that Körösladány-Bikeri was used in different periods throughout prehistory and history (see Chapter 4, this volume). Although there was a substantial prehistoric Early Copper Age occupation at Körösladány-Bikeri, our excavations also identified several features associated with the post–Copper Age use of the locale.

Bayesian and contextual analyses of 10 calibrated radiocarbon dates from the site grouped into two relatively distinct Early Copper Age phases (Table 8.1). Owing to various natural and anthropogenic processes that occurred in the Copper Age and during subsequent periods, the evolution of the settlement layout is less clear at Körösladány-Bikeri than at Vésztő-Bikeri. Figure 8.6 depicts a schematic of the contemporaneous features at Körösladány-Bikeri at different points during the Early Copper Age.

The First Early Copper Age Phase at Körösladány-Bikeri

Two radiocarbon samples came from primary contexts in features associated with the First Early Copper Age Phase at the Körösladány-Bikeri site (Table 8.1; Figure 8.7): one from the fill of the Feature 29 ditch in Block 4, and one from the fill of Feature 28, a bell-shaped storage/refuse pit recovered in the same excavation block. The summed probabilities (1σ) for these two dates range from 4447 to 4335 cal BC. Bayesian modeling puts the starting boundary for the First Early Copper Age Phase at this site

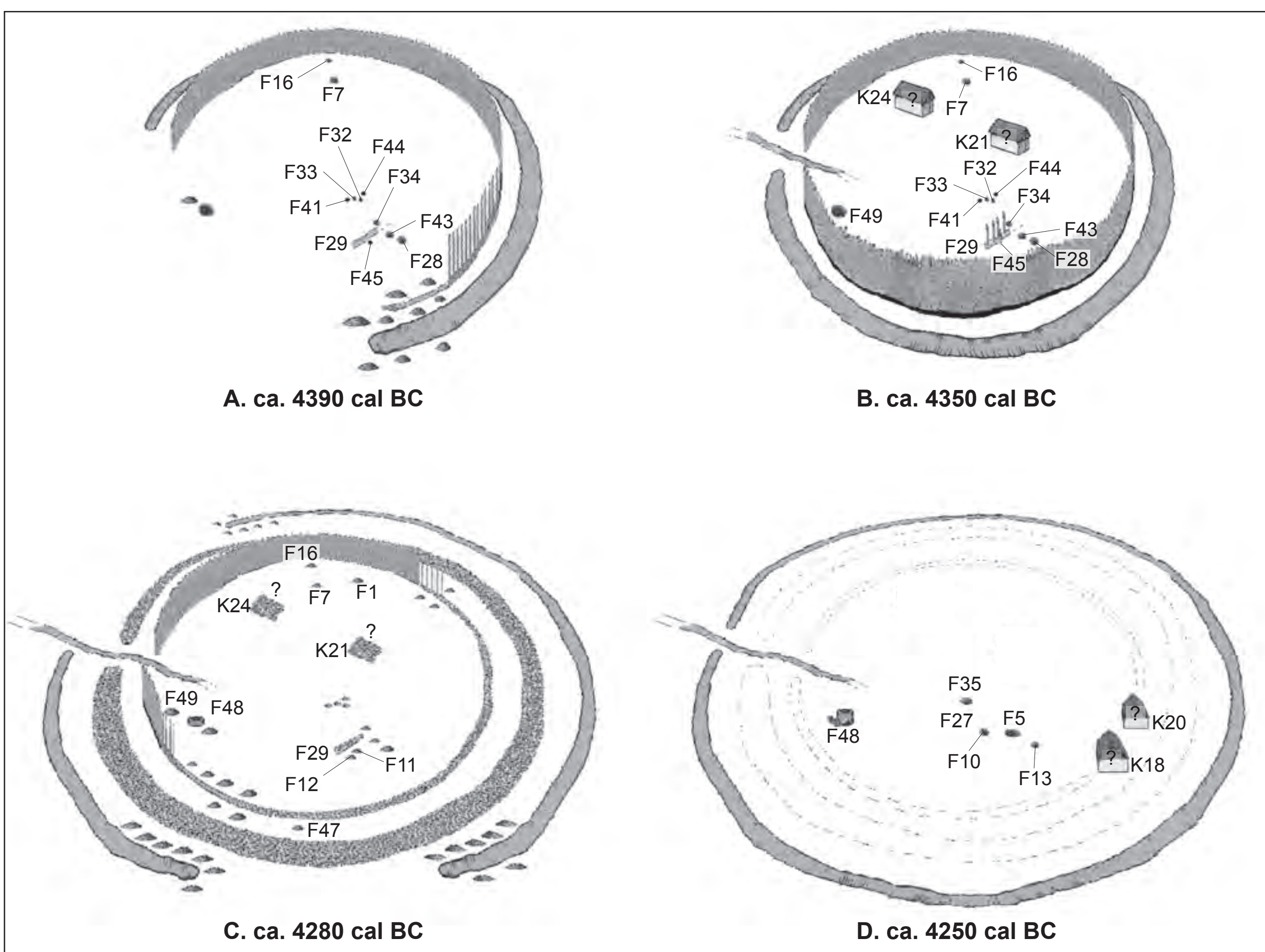


Figure 8.6. Schematic reconstructions of Körösladány-Bikeri during different Early Copper Age phases. A: First Early Copper Age Phase, circa 4390 cal BC; B: First Early Copper Age Phase, circa 4350 cal BC; C: Second Early Copper Age Phase, circa 4280 cal BC; D: Second Early Copper Age Phase, circa 4250 cal BC. *Figure by Richard W. Yerkes and Jill Seagard.*

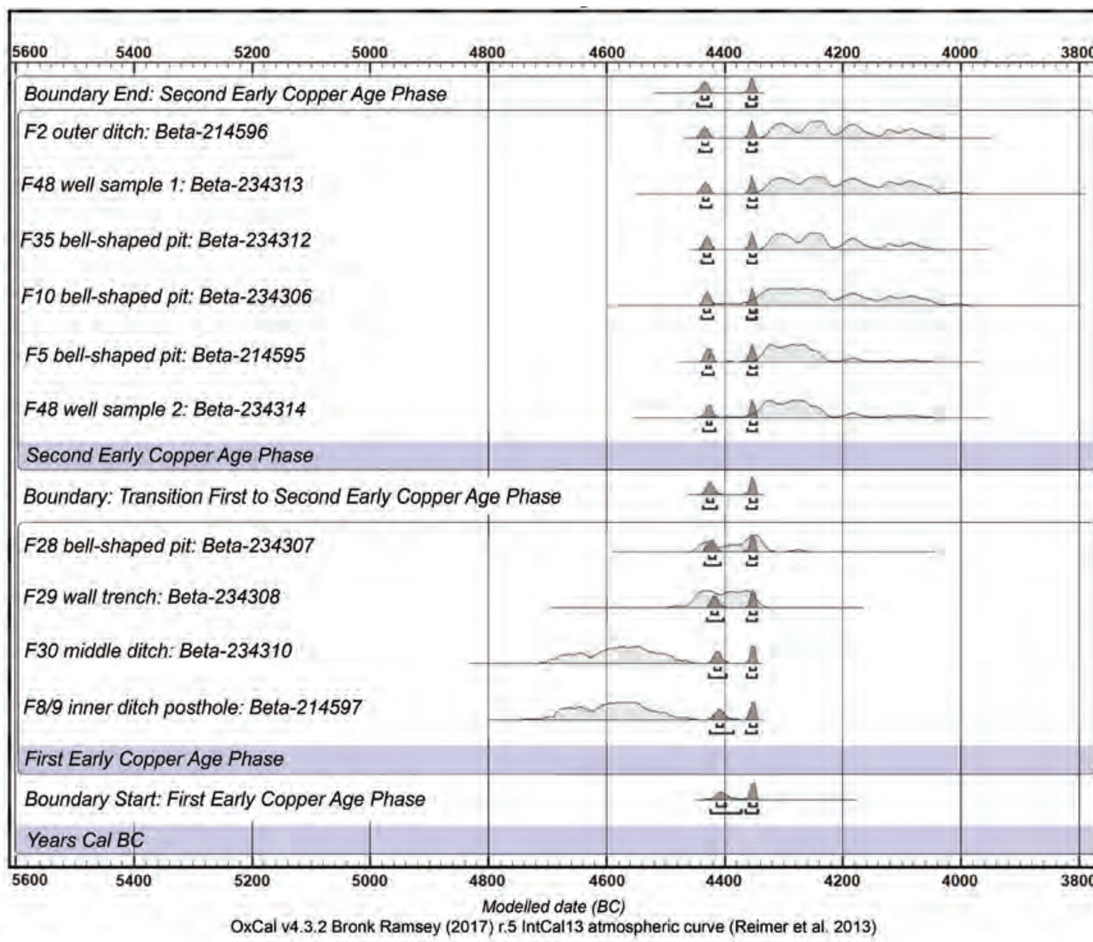


Figure 8.7. Calibrated radiocarbon dates from Körösladány-Bikeri. *Figure by Richard W. Yerkes and Jill Seagard.*

between 4512 and 4355 cal BC (mean = 4410 cal BC) and the ending boundary between 4433 and 4267 cal BC (mean = 4271 cal BC).

These dates fall within the time span of the second, main occupation period at Vésztő-Bikeri, indicating that some activities occurred at Körösladány-Bikeri before habitation at Vésztő-Bikeri terminated. Two dates on charcoal samples from the palisade ditch (Feature 8/46) and the middle ditch (Feature 30) in Block 5 were earlier than the dates from this First Early Copper Age Phase at Körösladány-Bikeri (Table 8.1; Figure 8.7). The range for the summed probabilities (1σ) is 4678–4504 cal BC, even earlier than the three early dates from Vésztő-Bikeri. These samples may have come from older charred materials that were incorporated into the enclosure fills at Körösladány-Bikeri (Yerkes et al. 2009).

As at Vésztő-Bikeri, a 15–20 cm–thick paleosol layer covers the loess subsoil at Körösladány-Bikeri. The total depth of intact anthropogenic layers across the site ranges between 20 and 30 cm—much less than at Vésztő-Bikeri. Where lower and upper Early Copper Age cultural layers could be distinguished, the lower sequence, associated with the First Early Copper Age Phase at Körösladány-Bikeri, measures 10–15 cm in thickness. As at Vésztő-Bikeri, the cultural layers may have been accumulated through residential activities as well as through intentional mounding and leveling.

During the First Early Copper Age Phase at Körösladány-Bikeri, excavations for the palisade ditch (Feature 8/46) and the large, trapezoidal middle ditch (Feature 30) may have been started to enclose the site (Figures 8.6A–B and 8.8). The magnetic survey indicates that the maximum diameter of the middle ditch was about 50 m, surrounding an area of 0.2 ha, and the palisade diameter was about 40 m in this period, enclosing an area of around 0.13 ha. Deposits from the ditches and palisade may have been used to build up the center of the site during this period.

Although rectangular linear anomalies were identified in the magnetic map at Körösladány-Bikeri (for example, anomalies K15, K17, K18, K20, K21, K22, and K24; see Figure 6.5), they were less clear than those at Vésztő-Bikeri. In fact, a ditch with postholes in Block 4 (Feature 29) is the only potential feature we excavated at Körösladány-Bikeri that may have been a wall trench of a building (Figures 8.6A–B and 8.8). Our stratigraphic observations associate this feature with the First Early Copper Age Phase at the site.

In addition to Feature 28 in Block 4, which was truncated by the plowzone but associated with an absolute date, several other excavated pits also were dug and used for storage and refuse during the First Early Copper Age Phase at Körösladány-Bikeri. These pits (Features 16, 32, 33, 34, 43, and 49) vary in size and depth and were exposed in various sections of the site, particularly in Block 4, southeast of the central area (Figure 8.8). Some postholes, such as Features 18, 41, 44, and 45, also may date to this period. All these features were covered by the upper cultural layer, which is associated with the Second Early Copper Age Phase at the site.

The Second Early Copper Age Phase at Körösladány-Bikeri

Six calibrated radiocarbon dates were run on samples from the fill of three bell-shaped storage/refuse pits (Features 5, 10, 35), the well (Feature 48), and the outer ditch (Feature 2). These features were associated with the Second Early Copper Age Phase at Körösladány-Bikeri (Table 8.1; Figure 8.7). The six dates are statistically similar at the 95 percent level ($T = 1.62$, critical value = 11.1, df = 5, .05 level). Summed probabilities (1σ) for these dates are 4337–4174 cal BC (median = 4255.5 cal BC). The summed probabilities for these dates and for the dates from the First Early Copper Age Phase do not overlap. There may have been a hiatus or break in the use of the site before the Second Early Copper Age Phase began. However, we did not find any evidence for pedogenesis in the upper cultural layer, so the time that passed between the occupation episodes may not have been very long. Bayesian modeling puts the starting boundary for the Second Early Copper Age Phase between 4346 and 4263 cal BC (mean = 4313 cal BC) and the ending boundary between 4303 and 4223 cal BC (mean = 4244 cal BC).

When distinguishable in the stratigraphy, the intact upper cultural layer at Körösladány-Bikeri is thicker than the lower one, measuring around 15–20 cm. The plowzone is 25–30 cm thick across the site, but in some places, including the central section, it is more than 40 cm.

During our excavations, the trapezoidal outer ditch (Feature 2) became visible in Block 5 immediately below the plowzone and cut through the upper and lower cultural layers. This ditch may have been constructed during the Second Early Copper Age Phase, when the Copper Age inhabitants expanded the Körösladány-Bikeri village, after the large middle ditch (Feature 30) had been filled and the palisade (Feature 8/46) had been dismantled (Figure 8.6C). The diameter of the enclosure was enlarged from about 50 m to about 70 m at this time to surround an area of 0.38 ha; this value is similar to the area enclosed by the outer ditch at Vésztő-Bikeri. It is not clear whether this expansion occurred because the human population at Körösladány-Bikeri had increased from the First to the Second Early Copper Age Phase or if more space was needed to keep large herds of animals inside the outer ditch. In the blocks we excavated at the site, the density of features did not increase but actually declined during the Second Early Copper Age Phase, lending possible support to the latter idea. The layers in Feature 2 suggest that the outer ditch was filled in quickly, however not entirely, at the end of the Early Copper Age settlement at Körösladány-Bikeri.

We did not identify the remains of any structures that could be associated with the Second Early Copper Age Phase at Körösladány-Bikeri. However, the significant amounts of burned daub fragments collected during our gridded surface collections and excavated in Early Copper Age features provide indirect evidence for burned wattle-and-daub structures at Körösladány-Bikeri. Our excavations in the center of the site did not reveal structures. In fact, the only archaeological feature we identified in Block 6, a 40 m^2 area in the center of the site, was a bell-shaped pit at the base of the plowzone (Feature 35; Figures 8.6D and 8.9). The absence of other features in this excavation block suggests that either there was a central plaza or surface structures lacking wall trenches and deep timber posts were erected in this part of the village during the Early Copper Age. In this latter scenario, the lack of buildings dating to the Second Early Copper Age Phase at Körösladány-Bikeri may be due to the combined effects of systematic cleaning activities during the Early Copper Age, the reuse of the site during later periods, erosion, and modern farming practices.

Like the outer ditch of the enclosure, the pits associated with the Second Early Copper Age Phase (Features 5, 10, 13, 28, 35; Figures 8.6D and 8.9) were dug through the upper cultural layer that formed a mantle over the lower cultural layer and the filled-in features of the First Early

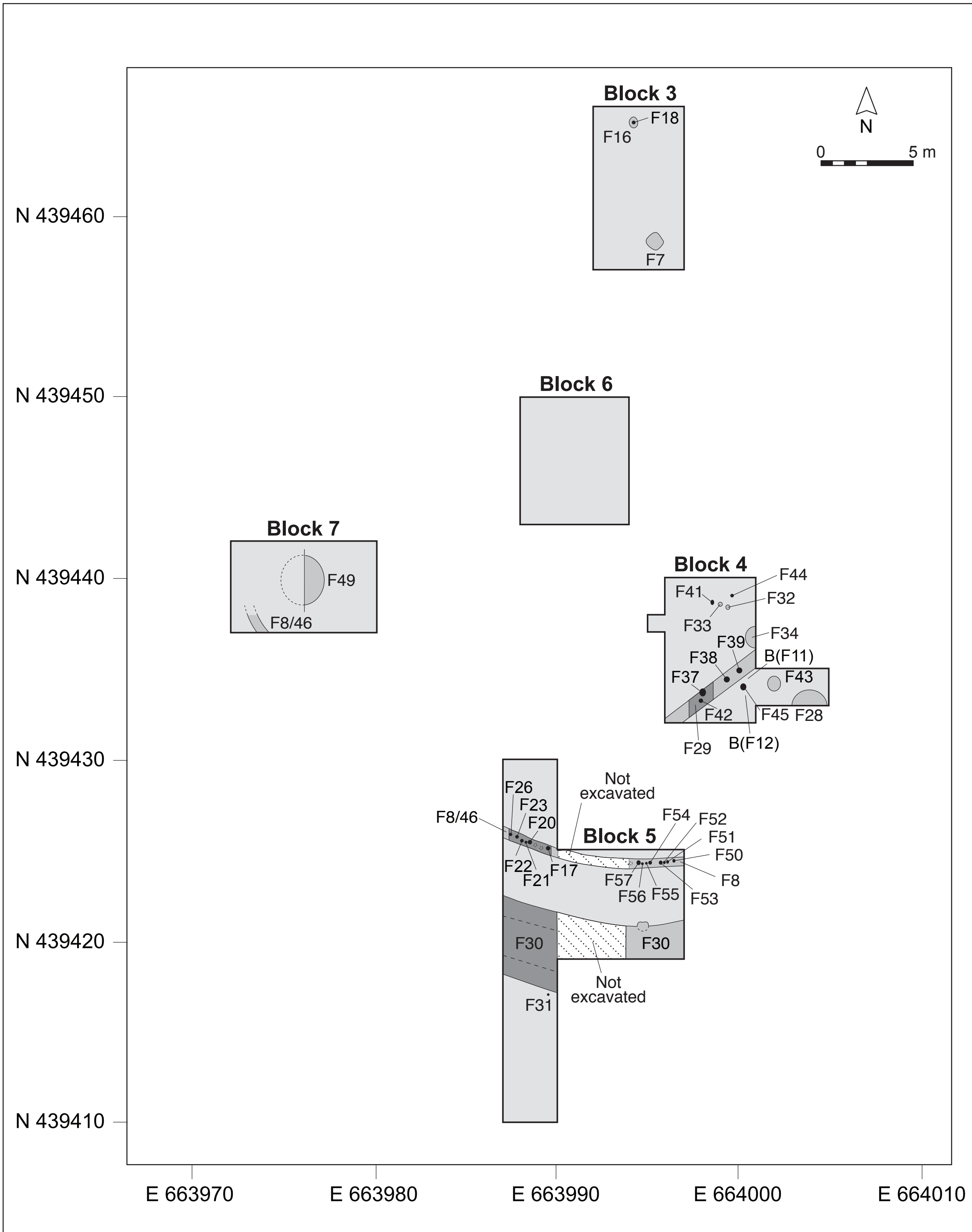


Figure 8.8. First Early Copper Age Phase features and excavated contexts at Körösladány-Bikeri based on calibrated radiocarbon dates and stratigraphy. Excavated areas are light shaded. Features that contained radiocarbon samples are dark shaded. Black dots are postholes; open circles are pits. *Figure by Richard W. Yerkes and Jill Seagard.*

Copper Age Phase. The well in Block 7 (Feature 48; Figures 8.6C–D and 8.9), located in the western section of the site, was in use in this period. The radiocarbon dates from the well fill may be associated with the latest use of the feature and possibly also the abandonment of the Early Copper Age village at Körösladány-Bikeri.

Soil chemistry survey at Körösladány-Bikeri identified high concentrations of phosphate around the perimeter of the site and lower levels in the central area (see Chapter 5, this volume). This pattern is similar to the results from Vésztő-Bikeri, and fits the model for agricultural villages where residents removed organic waste from living quarters and deposited their trash in ring middens at the perimeter of their settlements. However, the ring midden pattern is not as clear at Körösladány-Bikeri as it was at Vésztő-Bikeri (Yerkes et al. 2007), likely due to the post–Copper Age activities at the site. The unexcavated circular magnetic anomalies at the site may be interpreted as kilns, hearths, and storage/refuse pits, and they also distribute primarily in this outer zone of the settlement (see Figure 6.5).

Mortuary activities also occurred at the turn of the First and Second Early Copper Age Phases and during the Second Early Copper Age Phase at Körösladány-Bikeri. Three infants and one subadult burial were found during our excavations (see Chapter 16, this volume). The associated grave goods let us assign Features 11, 12, and 47 to the Early Copper Age (Figures 8.8 and 8.9). The highly fragmented human remains of Feature 1 in Block 3, however, were not associated with Tiszapolgár material and were exposed in a midden fill in the northern section of the site where later occupations concentrated at Körösladány-Bikeri (Figure 8.9). Therefore, the chronological association of this burial is uncertain. The skeletons of Features 11 and 12, both covered with Tiszapolgár vessels, were found on top of the lower cultural layer in Block 4. Feature 47 in Block 5, interred between the filled-in palisade ditch and the large middle ditch, was incorporated into the upper cultural layer.

Other Prehistoric and Historic Use of Körösladány-Bikeri

As at Vésztő-Bikeri, the very few Early Neolithic, Árpádian Age, and medieval ceramics from the site suggest that residential or other sorts of activities occurred at Körösladány-Bikeri in these periods. The site was used more intensively during the Late Bronze Age and the Sarmatian period (second to fourth century AD). Based on the artifacts in their fills, several pits excavated in Blocks 3, 4, and 5 date to these periods (Figure 8.10). The nested Late Bronze Age Gáva ceramic vessels from Feature 3 may be interpreted as a ceremonial assemblage.

Early Copper Age Settlement Layout and Use in the Bikeri Micro-Region and Beyond

After living on nucleated sites for many generations—in some cases perhaps as many as 10 generations—the farmers of the Great Hungarian Plain abandoned these large villages to establish their own autonomous settlements during the final stage of the Late Neolithic. This process unfolded gradually and may have occurred earlier in some parts of the Körös region than in other regions of the plain (Gyucha 2015; Gyucha et al. 2014).

Our studies at Vésztő-Bikeri and Körösladány-Bikeri verified that, contrary to previous interpretations (Bognár-Kutzián 1972:172; Siklódi 1983), many of the Early Copper Age villages were long-lasting sites that were occupied for multiple generations. Although intensive farming activities and erosion have resulted in the disturbance and loss of the uppermost parts of the cultural sequences at the sites, the thickness of intact Early Copper Age layers exceeds 0.6 m at Vésztő-Bikeri and is 0.3 m in places at Körösladány-Bikeri. Deep Tiszapolgár strata also were noted at the nearby Vésztő-Mágor tell (Hegedűs and Makkay 1987), located about 2 km north of the Bikeri villages, and at several other contemporaneous villages on the Great Hungarian Plain (e.g., Garašanin and Garašanin 1957; Siklódi 1982). These cultural layers developed as a result of consecutive building, mounding, and leveling episodes. Several features at these sites, such as the longhouses at Vésztő-Bikeri and the enclosure systems at both Bikeri sites, required significant labor investment and maintenance over long periods of time, indicating durable occupations well into the Early Copper Age.

Stratigraphic observations and calibrated radiocarbon dates permitted us to define multiple occupation periods at the Bikeri sites, and the surface collections, geophysical prospection, soil chemistry survey, and targeted excavations made possible the reconstruction of the layout and use of the villages during these periods.

The calibrated radiocarbon dates from Vésztő-Bikeri and Körösladány-Bikeri revealed a sequence of overlapping occupation episodes at these two adjacent sites (Figure 8.11). The Vésztő-Bikeri village was established and inhabited first, but there are overlaps between the span of the calibrated radiocarbon dates from the First Early Copper Age Phase at Körösladány-Bikeri and the Second Early Copper Age Phase at Vésztő-Bikeri, as well as the Second Early Copper Age Phase at Körösladány-Bikeri and the four later dates representing the Third Early Copper Age Phase of site use at Vésztő-Bikeri. These data suggest that the regular use of Körösladány-Bikeri

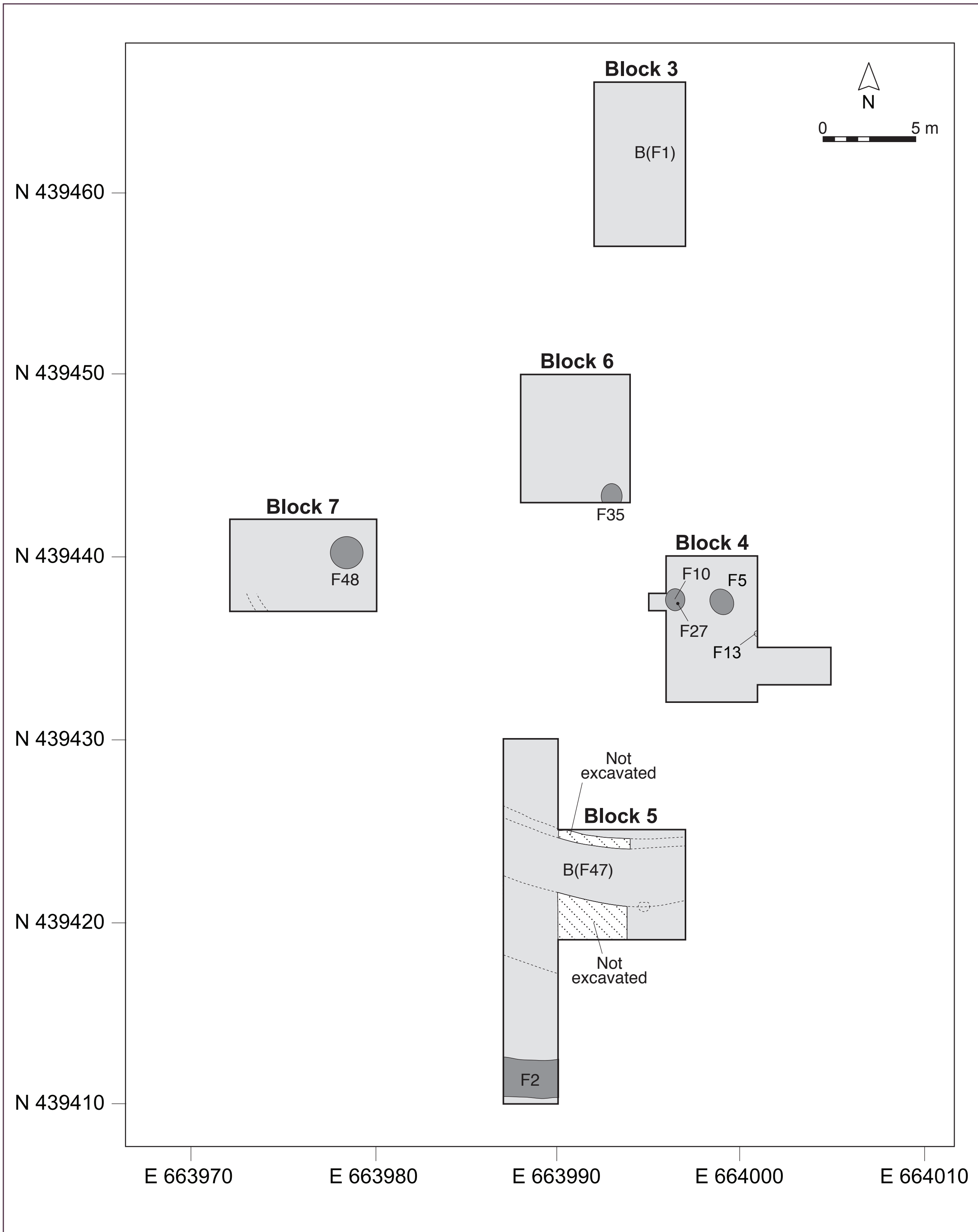


Figure 8.9. Second Early Copper Age Phase features and excavated contexts at Körösladány-Bikeri based on calibrated radiocarbon dates and stratigraphy. Excavated areas are light shaded. Features that contained radiocarbon samples are dark shaded. Black dots are postholes; open circles are pits. *Figure by Richard W. Yerkes and Jill Seagard.*

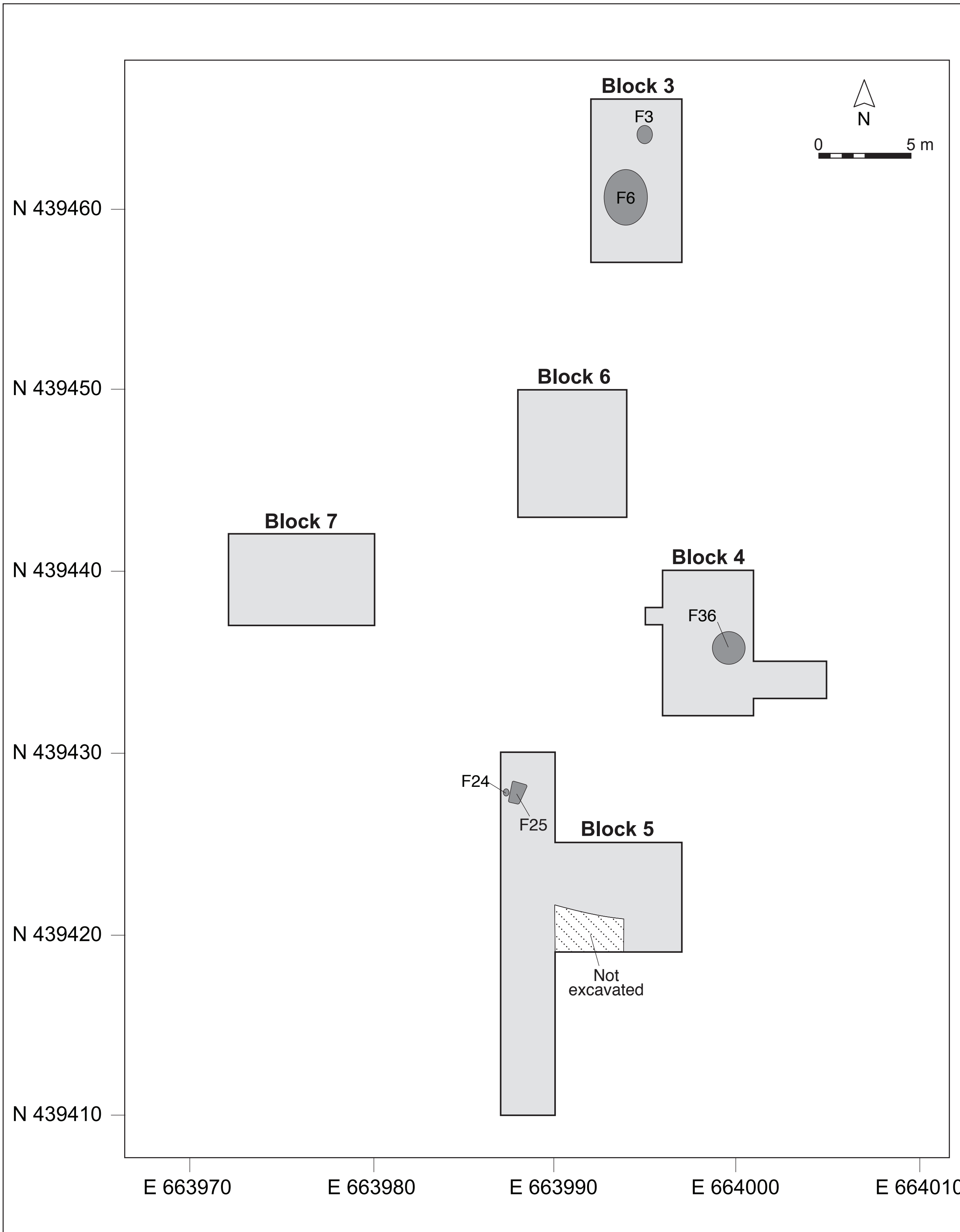


Figure 8.10. Intrusive features and excavated contexts at Körösladány-Bikeri based on stratigraphy and material culture. Excavated areas are light shaded. Open circles are pits. *Figure by Richard W. Yerkes and Jill Seagard.*

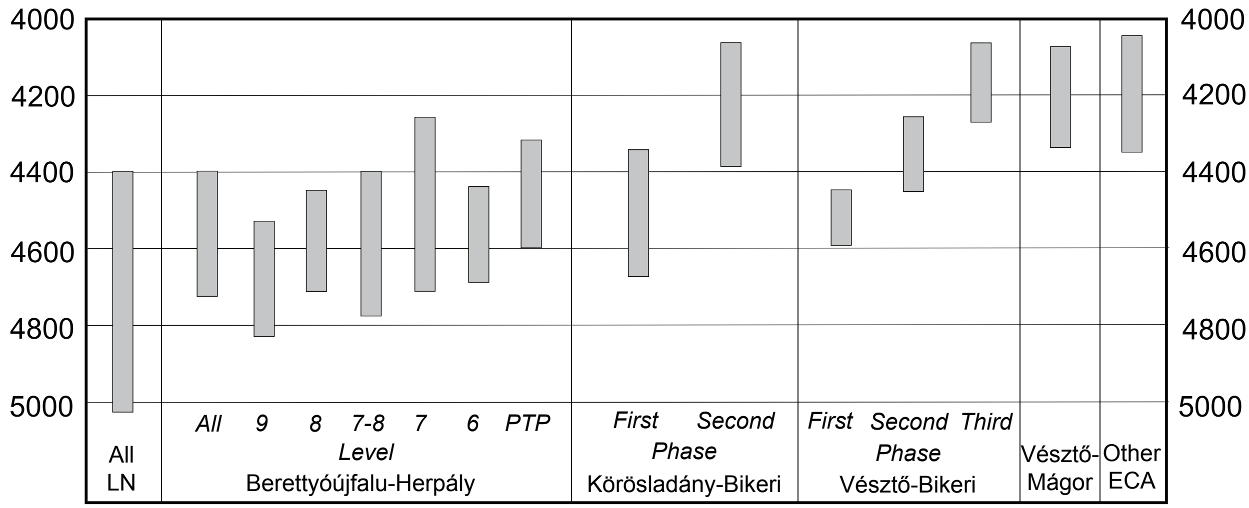


Figure 8.11. Summed probabilities (1σ) confidence intervals for 107 calibrated Late Neolithic and Early Copper Age radiocarbon dates from Late Neolithic tells, Late Neolithic and Proto-Tiszapolgár levels at the Berettyóújfalu-Herpály tell, Körösladány-Bikeri, Vésztő-Bikeri; an Early Copper Age (Tiszapolgár) date from the Vésztő-Mágor tell; 15 dates from other Early Copper Age sites. For details, see Yerkes et al. (2009). *Figure by Richard W. Yerkes and Jill Seagard.*

began while Vésztő-Bikeri was still occupied. Also, when Körösladány-Bikeri had reached its maximum spatial extent during its Second Early Copper Age Phase—although Vésztő-Bikeri might not have been occupied anymore—specific activities by the Körösladány-Bikeri inhabitants occurred at that site as well: the kilns or ovens at Vésztő-Bikeri probably were still in use, burials were interred, and refuse was still being discarded in the ring midden. These latest Early Copper Age phases at the Bikeri sites and the Tiszapolgár occupation on the Vésztő-Mágor tell all date to the second half of the Early Copper Age (circa 4350–4000 cal BC), suggesting that the two small Tiszapolgár settlements and the tell may have been inhabited or utilized simultaneously in the Vésztő micro-region. These dates also are contemporaneous with the range of published dates from other Tiszapolgár cemeteries and settlements on the Great Hungarian Plain (see below).

Settlement layout and use at Vésztő-Bikeri and Körösladány-Bikeri appear to have been similar during their occupations: domestic structures, where we found them, were located in the central section, food processing occurred immediately surrounding the structures, waste was deposited and livestock was kept in the outer settlement zones, and fortifications encircled the villages. Sedimentological and geochemical investigations identified an analogous spatial organization of activity zones at several other, small Early Copper Age sites across the Körös region (Salisbury 2016; see also Chapter 5, this volume). In contrast to the preceding Late Neolithic period (e.g., Kalicz and Raczky 1987b; Korek 1989; Raczky 2009), there is little evidence for multiple household clusters at these typically small (0.3 to 1 ha) villages. In fact, the areal extent and the organizational and functional characteristics of the small Tiszapolgár settlements themselves were similar to those of the household clusters at large, nucleated Late Neolithic sites.

Vésztő-Bikeri provided a wealth of information about Early Copper Age domestic structures. Our results indicate that two or three houses may have been occupied simultaneously at that village. This corresponds with information from other small Tiszapolgár sites in the Körös region where, on the basis of geophysical prospection, surface surveys, and excavations, one to three dwellings were in use at one time (Gyucha 2015). The size of the longhouses in the center of Vésztő-Bikeri ranged from 5 x 9 m (Structure A1; see Figure 6.3) to 6.4 x 14.4 m (Feature 15), with the estimated areas of their thin, packed-earth floors ranging from 43 m^2 to 92 m^2. These dimensions are much larger than the mean (26 m^2) and median (22 m^2) floor areas of the nine houses previously excavated at Tiszapolgár sites and measured by Parkinson (2006a:273). They are closer to the mean (74 m^2) and median (60 m^2) areas of the 12 Late Neolithic structures in his sample from the Great Hungarian Plain (Parkinson 2006a:272 and Table 7.1). However, in contrast to their Late Neolithic counterparts, the longhouses from Vésztő-Bikeri were not divided into rooms, and no ovens, hearths, or built-in storage features were identified inside the structures (Gyucha et al. 2006; Parkinson et al. 2004b, 2010b; Sarris et al. 2004). The almost complete lack of wall trenches at Körösladány-Bikeri may be indicative of fundamental changes in building methods, and perhaps activities and social groups associated with domestic structures, over time. It also is possible that the structures at Körösladány-Bikeri were carefully cleared out and dismantled, like Feature 15 at Vésztő-Bikeri, leaving few traces that could be detected through magnetic surveys or excavations.

The well-preserved Features 4/14 and 5 at Vésztő-Bikeri offer insights into household organization at Tiszapolgár settlements. The discrete spatial distribution of different types of vessels in Feature 4/14 implies that storage occurred in the eastern section and that serving vessels were used primarily in the northwestern portion of that structure (Parkinson et al. 2004b; see also Chapter 7, this volume). Specialized arrowhead production, as well as the storage of finished products, took place in this latter area as well (see Figure 11.7). In addition to regular household activities implied by the large amount and broad variety of vessels, the several loom weights and spindle whorls found in Feature 5 are indicative of textile production in that building (see Chapter 13, this volume).

Besides the organization of settlements and the size of structures, other Late Neolithic traditions continued at the Early Copper Age Bikeri settlements. The *pisé de terre* construction technique of the Feature 15 structure at Vésztő-Bikeri was used on Late Neolithic structures at the nearby Vésztő-Mágor tell (Gyucha 2015; Gyucha et al. 2006). In regard to site formation processes, traditions of dismantling, leveling, and mounding over houses at the end of occupation episodes—frequently observed at Late Neolithic tells—also persisted into the Early Copper Age. However, as illustrated by the case of the adjacent longhouses of Features 15 and 4/14 at Vésztő-Bikeri, instead of rebuilding structures on top of one another and forming thick vertical sequences, Tiszapolgár groups built new structures and features adjacent to the abandoned ones. When the Vésztő-Bikeri settlement finally was abandoned, instead of building a new village on top of the old one in tell-like fashion, the group seems to have moved 70 m west and established a new settlement at Körösladány-Bikeri. Thus, although the Neolithic practice of building, leveling, and mounding continued at the small Early Copper Age villages, it did so on a smaller scale and over a few generations instead of several centuries. This is partly why these dispersed Early Copper Age sites did not eventually become tells.

The fortification systems of the Bikeri settlements, with ditches, palisades, and presumably ramparts, also had forerunners in the Neolithic (Parkinson and Duffy 2007; Raczky and Anders 2012), and similar enclosures were found at other Early Copper Age sites across the Great Hungarian Plain (Goldman and Szénászky 2012; Kovács et al. 2007; Siklódi 1982; Szilágyi 2010). Their construction required a scale of labor that exceeded the capacity of small villages, which we presume were inhabited by a maximum of a few dozen inhabitants. These enclosures represent a high degree of cooperation among the dispersed Early Copper Age communities. However, as the hamlet at Okány-Futás in the Körös region indicates (see Chapter 6, this volume), many of the Tiszapolgár settlements also were unfortified. Gyucha (2015:183) argued that defensive constructions might have been more common at or near the boundaries between major sociopolitical units during the Early Copper Age.

Finally, the Neolithic tradition of burying the dead within settlement sites also continued into the Early Copper Age. At the Vésztő-Bikeri and Körösladány-Bikeri villages, as well as at many other sites in the Körös region (Gyucha 2015), burials seem to have occurred both during and after the occupation of Tiszapolgár villages. In the former case, as during the Late Neolithic, the dead were placed in unoccupied sections of the settlements (for details, see Chapter 16, this volume).

The Relative and Absolute Chronology of the Bikeri Sites in Broader Context

In the 1980s and 1990s, calibrated radiocarbon dates were used to construct a revised chronology for the Neolithic and Copper Age on the Great Hungarian Plain. Older chronologies (Childe 1929, 1939; Makkay 1976, 1985) placed the Neolithic–Copper Age transition in the middle of the third millennium BC, but the revised calibrated chronologies pushed the transition back to the middle of the fifth millennium BC (Gläser 1996; Hertelendi et al. 1995; Raczky 1995a).

Three Late Neolithic (circa 5000–4500 cal BC) groups—Tisza, Herpály, and Csőszhalom—were identified on the Great Hungarian Plain. These archaeological units are roughly contemporaneous with the Lengyel I–II stages in Transdanubia and northern Hungary, the Iclod group and the Petreşti culture in Transylvania, and the Vinča B2–D2 phases in the northern Balkans (Bánffy 2007; Gläser 1996; Gyucha 2015; Hertelendi et al. 1998; Horváth and Hertelendi 1994; Kalicz and Raczky 1987a; Raczky 1988; Sherratt 1983a; Whittle 1996).

A transitional Proto-Tiszapolgár phase was defined in the uppermost layers of several Neolithic tells on the Great Hungarian Plain (Horváth 1985, 2005; Kalicz and Raczky 1984, 1987b). Some have recently rejected the concept of Proto-Tiszapolgár as a distinct chronological phase (Horváth 2014; Raczky and Anders 2016), but we find the term useful for discussing stylistic attributes within some transitional Late Neolithic and Early Copper Age ceramic assemblages. These stylistic changes, and thus the transitional Proto-Tiszapolgár phase, did not occur simultaneously in each region of the Great Hungarian Plain, or at the same pace.

The Early Copper Age is marked by the emergence of the Tiszapolgár cultural unit largely in the areas where the Tisza, Herpály, and Csőszhalom groups had been located during the Late Neolithic. Based primarily on samples from large cemeteries, Tiszapolgár-Basatanya in particular, the period previously was dated from 4410 to 3760 cal BC (Hertelendi et al. 1995), 4500/4400 to 4000 cal BC (Raczky 1995a), and 4350 to 3800 cal BC (Gläser 1996). The new radiocarbon dates from Vésztő-Bikeri and Körösladány-Bikeri increased the number of calibrated Early Copper Age dates from 15 to 47 on the Great Hungarian Plain. Based on the summed probabilities (1σ) for these 47 dates, our recent analysis indicated that the Tiszapolgár period dates from 4455 to 4079 cal BC (Yerkes et al. 2009). Moreover, a total of 168 dates from Neolithic and Copper Age sites on the Great Hungarian Plain demonstrated that several large, nucleated Late Neolithic settlements, some tell layers and sites assigned to the Proto-Tiszapolgár phase, and some small dispersed villages with Early Copper Age Tiszapolgár material culture were contemporaneous. This temporal overlap was not apparent until we included new calibrated dates from our excavations at Vésztő-Bikeri and Körösladány-Bikeri.

More details about the absolute and relative dating of the Bikeri sites are available in Yerkes et al. (2009). For convenience, we summarize the results here to provide a broader context for the patterns of use at these settlements during the Early Copper Age.

The summed probabilities (1σ) for the 22 Early Copper Age dates from Vésztő-Bikeri range from 4459 to 4253 cal BC. The summed probabilities (1σ) for the 10 dates from Körösladány-Bikeri have a larger range, from 4580 to 4078 cal BC, due to multiple intercepts on the calibration curve (Table 8.1; Figures 8.2 and 8.7). The older dates from Vésztő-Bikeri and Körösladány-Bikeri (4650–4450 cal BC) are earlier than the reported 15 dates from other Tiszapolgár settlements and cemeteries, which range from 4348 to 4052 cal BC and overlap the dates from the uppermost Neolithic layers at the Berettyóújfalu-Herpály tell, located in the adjacent Berettyó River valley (Kalicz et al. 2011). Some of these dates from the Bikeri sites may be from older, recycled wooden posts or other older, charred materials, but there is also significant overlap between the range for the summed probabilities (1σ) for the main, second phase at Vésztő-Bikeri, the First Early Copper Age Phase at Körösladány-Bikeri, the summed probability range for Late Neolithic Layers 8-7 and 7 at the Berettyóújfalu-Herpály tell, and the Proto-Tiszapolgár Layer 5 at that tell (Figure 8.11). Thus, based on the new ^{14}C dates from the Vésztő-Bikeri and Körösladány-Bikeri settlements, it is possible that the population dispersal from tells and other large, nucleated settlements—signaling the end of the Late Neolithic and the beginning of the Early Copper Age—may have begun earlier in the Körös region than elsewhere on the Great Hungarian Plain. Unfortunately, the lack of absolute dates from systematically excavated contexts from other Tiszapolgár settlements in the region makes it difficult to assess this assertion.

Conclusions

Our multidisciplinary studies provided new temporal and habitual contexts for changes in community organization during the transition from the Neolithic to the Copper Age on the Great Hungarian Plain. In contrast to the received knowledge that most Early Copper Age settlements were ephemeral and, presumably, plowed out (Bognár-Kutzián 1972; Sherratt 1984), our excavations recovered relatively thick Early Copper Age occupation layers preserved below the modern plowzone, as well as verified that Vésztő-Bikeri and Körösladány-Bikeri were used subsequently by the same community, each for multiple generations. The basic layout of the two sites seems to have remained the same, with ditches and a palisade surrounding a ring midden at the periphery, and houses and storage/refuse pits near the center. The spatial organization and use of these Early Copper Age settlements bear resemblances to Late Neolithic household clusters, indicating that the small, dispersed Tiszapolgár sites likely were established by extended family groups that abandoned the larger, nucleated Late Neolithic villages. Dates from the initial occupations at the Bikeri sites also suggest that the abandonment of these sites and the development of Tiszapolgár cultural traditions may have begun earlier in the Körös region than in other parts of the Great Hungarian Plain.

Part IV

Material Studies from Vésztő-Bikeri and Körösladány-Bikeri

Chapter 9

The Ceramic Assemblages: Typology, Style, and Function

Attila Gyucha and William A. Parkinson

This chapter presents the typological, stylistic, and functional analyses of the Early Copper Age ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri. Chapter 10 discusses the results of elemental, mineralogical, petrographic, and residue analyses of ceramic samples from these sites.

The ceramic assemblages were recovered during gridded surface surveys and excavations at the Bikeri villages between 2000 and 2006 (see Chapters 4 and 7, this volume) and constitute the largest systematically collected and analyzed ceramic materials from Early Copper Age contexts in the Carpathian Basin. The first comprehensive ceramic analysis of the Tiszapolgár culture—aimed to produce a typological classification of vessel forms—was conducted by Bognár-Kutzián (1963, 1972) in two ground-breaking monographs. After that, Slovakian Tiszapolgár ceramic assemblages were classified by Šiška (1968), and Iercoşan (2002) and Diaconescu (2009) carried out typological and stylistic analyses on Romanian materials. Most recently, Szilágyi (2015) performed meticulous statistical studies on several Tiszapolgár assemblages from the middle Tisza region using the technique developed originally for Early Copper Age assemblages in the Körös region by Parkinson (1999, 2006a). During his dissertation research, Parkinson conducted systematic stylistic investigations of Tiszapolgár ceramics at the regional scale to gain a better understanding of the social organization of and interaction between Early Copper Age communities. The methodology developed for Parkinson's study provided the groundwork for the current analysis of the Bikeri ceramic assemblages.

Overview of the Ceramic Assemblages and Analytical Techniques

During the excavations at Vésztő-Bikeri and Körösladány-Bikeri, a total of 92,572 ceramics were collected. Of these, 20,328 diagnostic pieces (22 percent) were subject to detailed typological and stylistic analyses (Tables 9.1–9.2). Additionally, 293 diagnostic sherds of the 1,495 ceramics collected during the gridded surface collection at Körösladány-Bikeri in 2003 also were included in our studies. In this context, "diagnostic" ceramics include rims, bases, handles, and decorated sherds, as well as body sherds that can be assigned to a specific chronological period other than the Early Copper Age based on specific characteristics (such as temper, decoration, or vessel type). The overwhelming majority of diagnostic specimens in both assemblages represent the Early Copper Age Tiszapolgár culture.

Almost all the 72,345 ceramics in the Vésztő-Bikeri assemblage date to the Early Copper Age (Tables 9.1 and 9.3); only 0.05 percent represent other periods, including the Early Neolithic Körös culture (circa 6000–5500 cal BC),

Table 9.1. Summary statistics for the ceramic assemblage from Vésztő-Bikeri

Context	Body Sherds		Diagnostics		Total	
	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)
1998 "Dog Leash" Surface Collection	N/A	N/A	442	9,411	*442*	*9,411*
Block 1	404	3,228	163	2,457	*567*	*5,685*
Block 2	22,308	230,292	5,515	129,658	*27,823*	*359,950*
Block 3	15,136	118,751	3,202	115,344	*18,338*	*234,095*
Block 4	1,207	15,035	456	9,871	*1,663*	*24,906*
Block 5	102	605	23	501	*125*	*1,106*
Block 6	152	1,325	35	896	*187*	*2,221*
Block 7	5,708	67,483	1,871	40,260	*7,579*	*107,743*
Block 8	945	8,822	276	5,004	*1,221*	*13,826*
Block 9	11,074	120,743	3,326	65,819	*14,400*	*186,562*
Total	**57,036**	**566,284**	**15,309**	**379,221**	***72,345***	***945,505***
Total Used in Analysis	**57,036**	**566,284**	**14,867**	**369,810**	***71,903***	***936,094***

Notes: The 1998 surface collection is not included in the analyses. Sherds from periods other than the Early Copper Age recovered during our excavations are included as diagnostics. *Table by William A. Parkinson.*

Table 9.2. Summary statistics for the ceramic assemblage from Körösladány-Bikeri

Context	Body Sherds		Diagnostics		Total	
	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)
1998 "Dog Leash" Surface Collection	471	4,902	140	2,906	*611*	*7,808*
2003 Gridded Surface Collection	1,202	10,092	293	3,787	*1,495*	*13,879*
Block 1	195	1,502	59	557	*254*	*2,059*
Block 2	425	5,043	132	2,961	*557*	*8,004*
Block 3	3,143	31,214	898	13,769	*4,041*	*44,983*
Block 4	4,830	37,495	1,334	26,569	*6,164*	*64,064*
Block 5	2,916	27,836	1,205	16,074	*4,121*	*43,910*
Block 6	948	8,728	662	7,387	*1,610*	*16,115*
Block 7	2,751	28,023	1,171	31,745	*3,922*	*59,768*
Total	**16,881**	**154,835**	**5,894**	**105,755**	***22,775***	***260,590***
Total Used in Analysis	**16,410**	**149,933**	**5,754**	**102,849**	***22,164***	***252,782***

Notes: The 1998 surface collection is not included in the analyses. Sherds from periods other than the Early Copper Age recovered during our gridded collections and excavations are included as diagnostics. *Table by William A. Parkinson.*

the Late Bronze Age Gáva culture (circa 1300–900 cal BC), the Árpádian Age (eleventh to thirteenth century AD), and the medieval age (fourteenth to seventeenth century AD). As noted in Table 9.1, this total includes 442 diagnostic ceramics surface collected by Parkinson (2006a:118) during his dissertation research in 1998. A total of 71,903 sherds, including 14,867 diagnostics, were recovered during test excavations in 2000 and subsequent excavations in Blocks 1 to 9 (Table 9.1; see Chapter 7, this volume). When only excavated contexts are considered, Early Copper Age ceramics account for 99.7 percent of the identifiable diagnostics from Vésztő-Bikeri (Table 9.3). Surface ceramics collected by Parkinson in 1998 using a dog leash method (see Chapter 4, this volume) were not included in the current analysis.

Table 9.3. Chronological distribution of the Vésztő-Bikeri and Körösladány-Bikeri diagnostic ceramic assemblages

Period	Vésztő-Bikeri		Körösladány-Bikeri	
	NDI	%	NDI	%
Early Neolithic	2	0.01	6	0.1
Early Copper Age	14,829	99.7	5,280	91.8
Late Bronze Age	11	0.07	96	1.7
Sarmatian Period	0	0	96	1.7
Árpádian Age	20	0.1	85	1.5
Medieval Age	5	0.03	4	0.07
Modern	0	0	187	3.2
Total	**14,867**	**100**	**5,754**	**100**

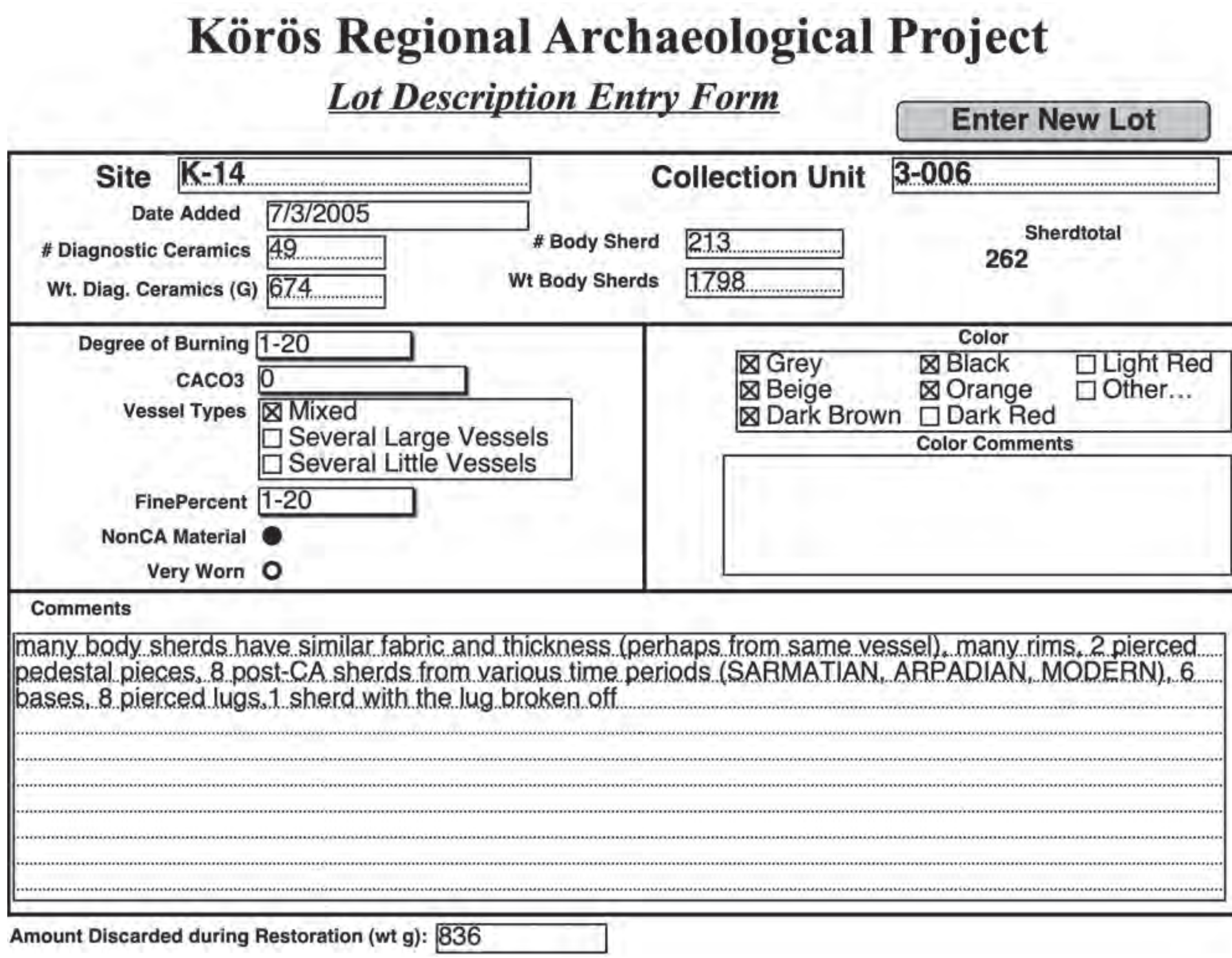
Notes: The Vésztő-Bikeri assemblage includes exclusively excavated materials, and the Körösladány-Bikeri assemblage includes materials collected during both gridded surface collection and excavations. NDI = number of diagnostics identifiable to a specific chronological period. *Table by Attila Gyucha and William A. Parkinson.*

At Körösladány-Bikeri, a total of 22,775 sherds were recovered during three phases of fieldwork: 611 sherds were collected during the 1998 surface collections by Parkinson (2006a:103), 1,495 sherds were found over an area of 5,350 m^2 during intensive gridded surface collections prior to excavations in 2005 (see Chapter 4, this volume), and a total of 20,669 sherds, including 5,461 diagnostics, were recovered from test trenches in 2001 and during excavations in 2005 and 2006 in Blocks 1 to 7 (Table 9.2; see Chapter 7, this volume). Nearly 92 percent of the ceramic material identifiable to specific periods from Körösladány-Bikeri can be assigned to the Early Copper Age Tiszapolgár culture (Table 9.3). In addition, the assemblage contains Early Neolithic Körös culture, Late Bronze Age Gáva culture, Sarmatian, Árpádian Age, medieval, and modern artifacts. The Gáva and Sarmatian ceramics were found typically in feature contexts, while sherds representing other periods were recovered from the plowzone or as stray finds in the cultural layer. The surface ceramics collected by Parkinson in 1998 were not considered in the present analysis, but sherds from the 2003 intensive gridded collection were included.

After being washed, ceramics were sorted using the Ceramic Lot Description form (Figure 9.1). The numbers and weights of diagnostics (defined above) and body sherds were recorded by excavation unit (EU), as was additional information about the degree of burning, variation in vessel type, color, and some basic chronological observations. Each diagnostic sherd then was described using the Diagnostic Ceramic Analysis form (Figure 9.2), based on methodology originally developed by Parkinson (2006a:79). During this process, specific variables were coded, focusing on those that were most useful for assessing variation within and between the Early Copper Age Bikeri assemblages. These include basic descriptive variables (such as length, width, thickness, and weight), variables associated with manufacturing process (such as inclusion and surface finish), and decoration (incised, for example). Vessel type was recorded using a simplified version of Bognár-Kutzián's (1963, 1972) typology. Additional details about the ceramic analysis are available in Parkinson (2006a:76–79).

Many sherds in the Bikeri assemblages were very weathered and fragmented; the combined mean weight of ceramic fragments (outliers excluded) in both assemblages was only 16.1 g. The standardized mean of sherd weight at Vésztő-Bikeri was about 3 g higher (around 17 g) than at Körösladány-Bikeri (around 14 g), perhaps as a result of the more intensive use of Körösladány-Bikeri during later periods.

Due to exposure to intense heat, a number of ceramics from Vésztő-Bikeri were deformed. There are 236 secondarily burned, frequently highly vitrified, diagnostic sherds from this site (1.6 percent of Early Copper Age diagnostics). Over half of these artifacts, 120 sherds, were found in the central area of the settlement, in Block 2, and are associated with the burning episode of Feature 4/14, a wattle-and-daub structure (see Chapters 7 and 8, this volume). Burned ceramics also were recovered in



Körös Regional Archaeological Project

Lot Description Entry Form

Enter New Lot

Site: K-14

Collection Unit: 3-006

Date Added: 7/3/2005

Diagnostic Ceramics: 49

Body Sherd: 213

Sherdtotal: 262

Wt. Diag. Ceramics (G): 674

Wt Body Sherds: 1798

Degree of Burning: 1-20

CACO3: 0

Vessel Types: ☒ Mixed ☐ Several Large Vessels ☐ Several Little Vessels

FinePercent: 1-20

NonCA Material: ●

Very Worn: ○

Color: ☒ Grey ☒ Black ☐ Light Red ☒ Beige ☒ Orange ☐ Other... ☒ Dark Brown ☐ Dark Red

Color Comments:

Comments: many body sherds have similar fabric and thickness (perhaps from same vessel), many rims, 2 pierced pedestal pieces, 8 post-CA sherds from various time periods (SARMATIAN, ARPADIAN, MODERN), 6 bases, 8 pierced lugs,1 sherd with the lug broken off

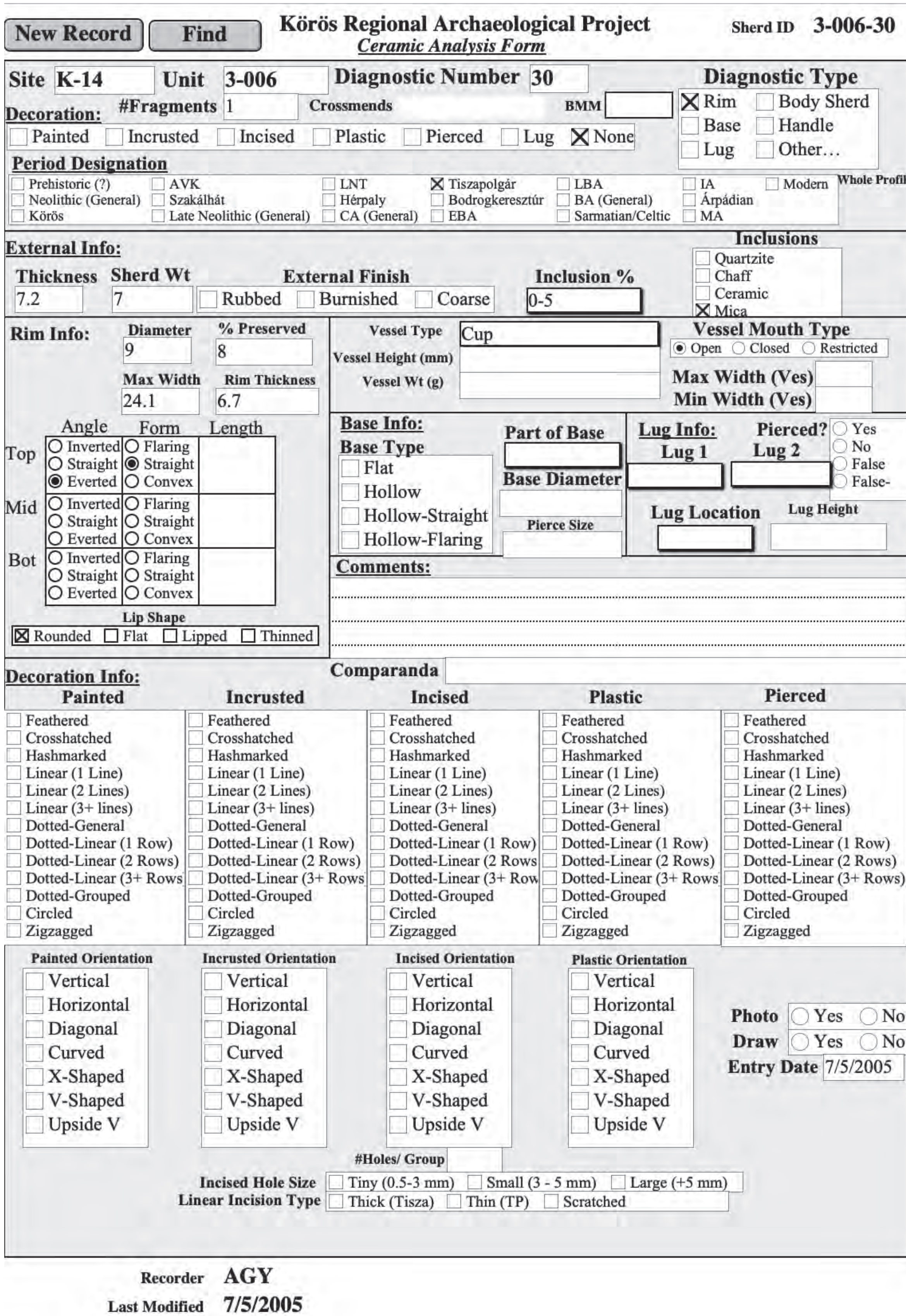
Amount Discarded during Restoration (wt g): 836

Figure 9.1. Ceramic lot description entry form used during analysis of the ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri. *Figure by William A. Parkinson.*

Block 9 (72, or 30.5 percent of burned diagnostic sherds) but most likely are not related to the Feature 15 building, since the rammed earth (*pisé de terre*) structure was not burned (see Chapters 7 and 8, this volume). A majority of burned sherds in this context were exposed in wall trenches or in cultural layers above the house floor. The burned sherds in trench fills might represent a burning episode during the Early Copper Age, prior to the construction of Feature 15, and fire from the adjacent and younger Feature 4/14 structure may have been responsible for burned artifacts in the cultural layer covering Feature 15. In much smaller quantities, burned diagnostic ceramics also were found in Block 3 (23, or 9.7 percent) and Block 7 (21, or 8.9 percent) at Vésztő-Bikeri. At Körösladány-Bikeri, the 12 secondarily burned Tiszapolgár diagnostic sherds (0.2 percent of Early Copper Age diagnostics) were distributed evenly across the site.

Ceramic Technology

The manufacturing techniques of Early Copper Age vessels at the Bikeri sites share numerous common characteristics. Dried clay and, less frequently, crushed ceramics (grog) were used as temper, while chaff and sand inclusions occur only very rarely. In the Körösladány-Bikeri assemblage, the frequency of sand temper appears to be slightly higher, and a few examples with graphite inclusion also can be found at that site. Depending on vessel type and size, the primary forming techniques included pinching as well as coil and slab building. Smoothing,


New Record | Find

Körös Regional Archaeological Project
Ceramic Analysis Form

Sherd ID 3-006-30

Site K-14 | Unit 3-006 | Diagnostic Number 30

Diagnostic Type: ☒ Rim ☐ Body Sherd ☐ Base ☐ Handle ☐ Lug ☐ Other…

Decoration: #Fragments 1 | Crossmends | BMM

☐ Painted ☐ Incrusted ☐ Incised ☐ Plastic ☐ Pierced ☐ Lug ☒ None

Period Designation

☐ Prehistoric (?) ☐ AVK ☐ LNT ☒ Tiszapolgár ☐ LBA ☐ IA ☐ Modern
☐ Neolithic (General) ☐ Szakálhát ☐ Hérpaly ☐ Bodrogkeresztúr ☐ BA (General) ☐ Árpádian
☐ Körös ☐ Late Neolithic (General) ☐ CA (General) ☐ EBA ☐ Sarmatian/Celtic ☐ MA

Whole Profile

External Info:

Thickness 7.2 | Sherd Wt 7 | External Finish: ☐ Rubbed ☐ Burnished ☐ Coarse | Inclusion % 0-5

Inclusions: ☐ Quartzite ☐ Chaff ☐ Ceramic ☒ Mica

Rim Info: Diameter 9 | % Preserved 8 | Max Width 24.1 | Rim Thickness 6.7

Vessel Type Cup | Vessel Height (mm) | Vessel Wt (g)

Vessel Mouth Type: ◉ Open ○ Closed ○ Restricted

Max Width (Ves) | Min Width (Ves)

	Angle	Form	Length
Top	○ Inverted ○ Straight ◉ Everted	○ Flaring ◉ Straight ○ Convex	
Mid	○ Inverted ○ Straight ○ Everted	○ Flaring ○ Straight ○ Convex	
Bot	○ Inverted ○ Straight ○ Everted	○ Flaring ○ Straight ○ Convex	

Lip Shape: ☒ Rounded ☐ Flat ☐ Lipped ☐ Thinned

Base Info: Base Type: ☐ Flat ☐ Hollow ☐ Hollow-Straight ☐ Hollow-Flaring

Part of Base | Base Diameter | Pierce Size

Lug Info: Lug 1 | Lug 2 | Pierced? ○ Yes ○ No ○ False ○ False-

Lug Location | Lug Height

Comments:

Comparanda

Decoration Info:

Painted	Incrusted	Incised	Plastic	Pierced
☐ Feathered	☐ Feathered	☐ Feathered	☐ Feathered	☐ Feathered
☐ Crosshatched	☐ Crosshatched	☐ Crosshatched	☐ Crosshatched	☐ Crosshatched
☐ Hashmarked	☐ Hashmarked	☐ Hashmarked	☐ Hashmarked	☐ Hashmarked
☐ Linear (1 Line)	☐ Linear (1 Line)	☐ Linear (1 Line)	☐ Linear (1 Line)	☐ Linear (1 Line)
☐ Linear (2 Lines)	☐ Linear (2 Lines)	☐ Linear (2 Lines)	☐ Linear (2 Lines)	☐ Linear (2 Lines)
☐ Linear (3+ lines)	☐ Linear (3+ lines)	☐ Linear (3+ lines)	☐ Linear (3+ lines)	☐ Linear (3+ lines)
☐ Dotted-General	☐ Dotted-General	☐ Dotted-General	☐ Dotted-General	☐ Dotted-General
☐ Dotted-Linear (1 Row)	☐ Dotted-Linear (1 Row)	☐ Dotted-Linear (1 Row)	☐ Dotted-Linear (1 Row)	☐ Dotted-Linear (1 Row)
☐ Dotted-Linear (2 Rows)	☐ Dotted-Linear (2 Rows)	☐ Dotted-Linear (2 Rows	☐ Dotted-Linear (2 Rows)	☐ Dotted-Linear (2 Rows)
☐ Dotted-Linear (3+ Rows	☐ Dotted-Linear (3+ Rows	☐ Dotted-Linear (3+ Row	☐ Dotted-Linear (3+ Rows	☐ Dotted-Linear (3+ Rows)
☐ Dotted-Grouped	☐ Dotted-Grouped	☐ Dotted-Grouped	☐ Dotted-Grouped	☐ Dotted-Grouped
☐ Circled	☐ Circled	☐ Circled	☐ Circled	☐ Circled
☐ Zigzagged	☐ Zigzagged	☐ Zigzagged	☐ Zigzagged	☐ Zigzagged

Painted Orientation	Incrusted Orientation	Incised Orientation	Plastic Orientation
☐ Vertical	☐ Vertical	☐ Vertical	☐ Vertical
☐ Horizontal	☐ Horizontal	☐ Horizontal	☐ Horizontal
☐ Diagonal	☐ Diagonal	☐ Diagonal	☐ Diagonal
☐ Curved	☐ Curved	☐ Curved	☐ Curved
☐ X-Shaped	☐ X-Shaped	☐ X-Shaped	☐ X-Shaped
☐ V-Shaped	☐ V-Shaped	☐ V-Shaped	☐ V-Shaped
☐ Upside V	☐ Upside V	☐ Upside V	☐ Upside V

Photo ○ Yes ○ No
Draw ○ Yes ○ No
Entry Date 7/5/2005

#Holes/ Group

Incised Hole Size ☐ Tiny (0.5-3 mm) ☐ Small (3 - 5 mm) ☐ Large (+5 mm)
Linear Incision Type ☐ Thick (Tisza) ☐ Thin (TP) ☐ Scratched

Recorder AGY
Last Modified 7/5/2005

Figure 9.2. Diagnostic ceramic analysis form used during analysis of the ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri. *Figure by William A. Parkinson.*

burnishing, and rubbing occur commonly on the exterior—in the case of bowls also on the interior—of the ceramics. These procedures were carried out when the vessels were leather-hard.

Pebble tracks of smoothing, fingerprints, fingernail impressions, stick marks, and scratches are evident on several bases; some of these may be interpreted as maker's marks. Holes penetrating sherds, renewed clay layers, and traces of additional firing on a few items indicate that vessels occasionally were repaired and, presumably, curated. Although ceramic slag was found at both Bikeri sites, features unambiguously associated with ceramic production—such as pottery kilns—were not identified during the excavations. The two small kilns or ovens at Vésztő-Bikeri (Features 35 and 105; see Chapter 7, this volume) more likely were related to food processing than to ceramic manufacture.

The majority of Early Copper Age ceramics from both sites were poorly executed, coarse wares with wall thickness up to 3 cm, defined by vessel size, form, and function. Thin slips of clay, sometimes including stick or other organic impressions, routinely were applied over the surface of storage vessels, and a dark brown slip occurs on the exterior of some cooking vessels. In a few cases, boiling lines are visible on the interior of pots. The coarse vessels are brown, yellowish brown, grayish brown, and reddish brown. Darker patches due to uneven firing conditions frequently were identified.

Fine wares comprise roughly one-fourth of the Bikeri assemblages, and "intermediate" ceramics with characteristics of both coarse and fine wares also are abundant. The wall thickness of the well-made, gray, brown, brownish-gray, red, and orange objects ranges between 0.3 and 0.7 cm. The outer surface of fine wares commonly is rubbed or highly burnished. These vessels were fired at high temperatures, often in an oxidized environment.

Typological Classification of the Early Copper Age Ceramic Assemblages from the Bikeri Sites

There are 86 complete vessel profiles in the Vésztő-Bikeri Early Copper Age assemblage, and an additional 40 objects have nearly complete profiles. In the Körösladány-Bikeri assemblage, these values are 41 and 32, respectively. Despite the lacuna of complete or nearly complete profiles, we were able to assign 10,903 of the diagnostic sherds to specific vessel types; this includes 7,815 from Vésztő-Bikeri (52.7 percent of Early Copper Age diagnostics) and 3,088 from Körösladány-Bikeri (58.5 percent).

Eight major vessel types were identified in the Bikeri ceramic assemblages: mugs, bowls, pots, jars, dippers, pedestalled vessels, lids, and perforated vessels (Table 9.4). Due to fragmentation, many of the diagnostic sherds could be classified only to these higher-order typological classes, and oftentimes it was not possible to determine more specific variants and subvariants. Descriptions of vessel types below address morphological characteristics as well as decorative motifs. We used Bognár-Kutzián's (1963, 1972) typological classification as reference material.

Table 9.4. Early Copper Age major vessel types in the ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri

Vessel Type	Vésztő-Bikeri		Körösladány-Bikeri	
	NDI	%	NDI	%
Mug	900	11.5	997	32.3
Bowl	3,277	42	680	22.1
Pot	1,535	19.6	371	12
Jar	466	6	152	4.9
Dipper	70	0.9	5	0.2
Pedestalled vessel	1,509	19.3	767	24.9
Lid	53	0.7	112	3.6
Perforated vessel	5	0.1	4	0.1
Total	**7,815**	**100**	**3,088**	**100**

Note: NDI = number of diagnostics identifiable to a specific vessel type. *Table by Attila Gyucha and William A. Parkinson.*

1. Mugs (Figures 9.3–9.6; Bognár-Kutzián Types A, B, and L)

This is the most common vessel type identified in the Körösladány-Bikeri ceramic assemblage and the fourth most frequent type at Vésztő-Bikeri (Table 9.4). During the analysis, mugs were differentiated from bowls of similar shapes by their rim diameter, which is smaller than 15 cm, and from pots of similar shapes by their height, which is smaller than 13 cm. When height data was not available, an arbitrary rim diameter value of 10 cm was applied to distinguish mugs from pots. A few tumblers (Type 1.E.b) exceed 13 cm in height, but analogous pot forms do not occur in the assemblages. Fourteen mugs have complete profiles from Körösladány-Bikeri, and there are 31 with complete profiles from Vésztő-Bikeri. Mugs are common among both the coarse and fine wares and likely served as drinking vessels. Five major variants are present in the Bikeri assemblages.

1.A. Mugs with convex or conical profiles (Figures 9.3 and 9.4A–C)

This is the most frequent mug type in the Bikeri assemblages, and it is characterized by remarkable morphological variability. On many occasions, the difference between conical and convex shapes is not distinct. Three subvariants were distinguished based on variation in shape and proportion of vessel sections: 1.A.a: The convex body narrows unevenly to the base, and the ratio between the diameter of the rim and the base is less than 2 to 1 (Figure 9.3A–D; Bognár-Kutzián Types A2e and A3c). 1.A.b: The convex body narrows less steeply and more evenly to the base, and the ratio between the diameter of the rim and the base is more than 2 to 1 (Figure 9.3E–G; not included in Bognár-Kutzián's typology). 1.A.c: The profile is conical (Figure 9.4A–C; Bognár-Kutzián Type A3b).

The height of all three subvariants ranges between 4 and 12 cm, typically 5 to 8 cm, and the diameter of the rim falls between 5 and 10 cm. These vessels may have one or two sets of two to four lugs placed symmetrically around the rim, in the upper and/or the middle section of the body and occasionally above the base. The spatial arrangement of lugs is sometimes haphazard, and vertically placed lugs also occur at or below the rim (Figure 9.3A–B). Fine ware specimens are infrequent, and the 12 mug fragments decorated with motifs other than lugs have horizontal or diagonal rows of small incised dots or groups of large incised dots. Finger indentations or hash marks seldom occur on the rims. A small number of miniature mugs also are present in the assemblages (e.g., Figure 9.3G). Four short, thick-walled objects from Vésztő-Bikeri may have been used as crucibles (e.g., Figure 9.4B). However, residue analysis has not been performed, and no evidence for metallurgical activities at the Bikeri sites was found.

1.B. Mugs with convex or conical lower parts and cylindrical upper sections (Figure 9.4D–H)

Complete profiles of this vessel type are scarce in the studied assemblages, and a moderate number of highly fragmented mug sherds also may represent this type. Two subvariants occur in the Bikeri assemblages: 1.B.a: The cylindrical upper section is short, and the ratio between the diameter of the rim and the base exceeds 1 to 2.5. Complete profiles measure 5 to 7 cm in height and 8 to 10 cm in rim diameter. Small lugs, typically round or semi-pointed in cross-section, commonly occur below the cylindrical section (Figure 9.4D–E; Bognár-Kutzián Type L2). 1.B.b: The cylindrical upper part constitutes more than 50 percent and less than 70 percent of the body, and the bottom section is convex. These mugs are 7 to 8.5 cm high, and the rims are 7 to 8 cm in diameter. Round, non-pierced, small lugs regularly were placed on the bulge (Figure 9.4F–H; not included in Bognár-Kutzián's typology). Both subvariants occur among both coarse and fine wares.

1.C. Barrel-shaped mugs (Figure 9.5A–D)

This type of mug is characterized by an elongated globular body and an explicitly inverted rim. It has two subvariants: 1.C.a: The vessel height exceeds the rim diameter (Figure 9.5A–B; Bognár-Kutzián Type A3a). 1.C.b: The rim diameter exceeds the vessel height (Figure 9.5C–D; similar to Bognár-Kutzián Type B3). Commonly, both subvariants occur among coarse wares in the Bikeri assemblages. Some of the few fine specimens have short vertical rims. The size range and types of decoration are similar to those of the mugs with convex or conical profiles (Type 1.A).

1.D. Collared mugs (Figure 9.5E–F; not included in Bognár-Kutzián's typology)

These vessels have gently everted rims and cylindrical or flaring collars, below which the profile is slender-globular or slightly biconical. The shape resembles that of the jars. The vessel height ranges between 10 and 13 cm, and the rim diameter between 6 and 10 cm. Collared mugs occur exclusively in the group of fine, carefully smoothed wares. In a small well-defined area on the floor of the Feature 4/14 longhouse in Block 2 at Vésztő-Bikeri, fragments of a minimum of nine nearly identical specimens were recovered (see Chapters 7, this volume). Ninety-seven percent of the collared mugs were recovered from Vésztő-Bikeri.

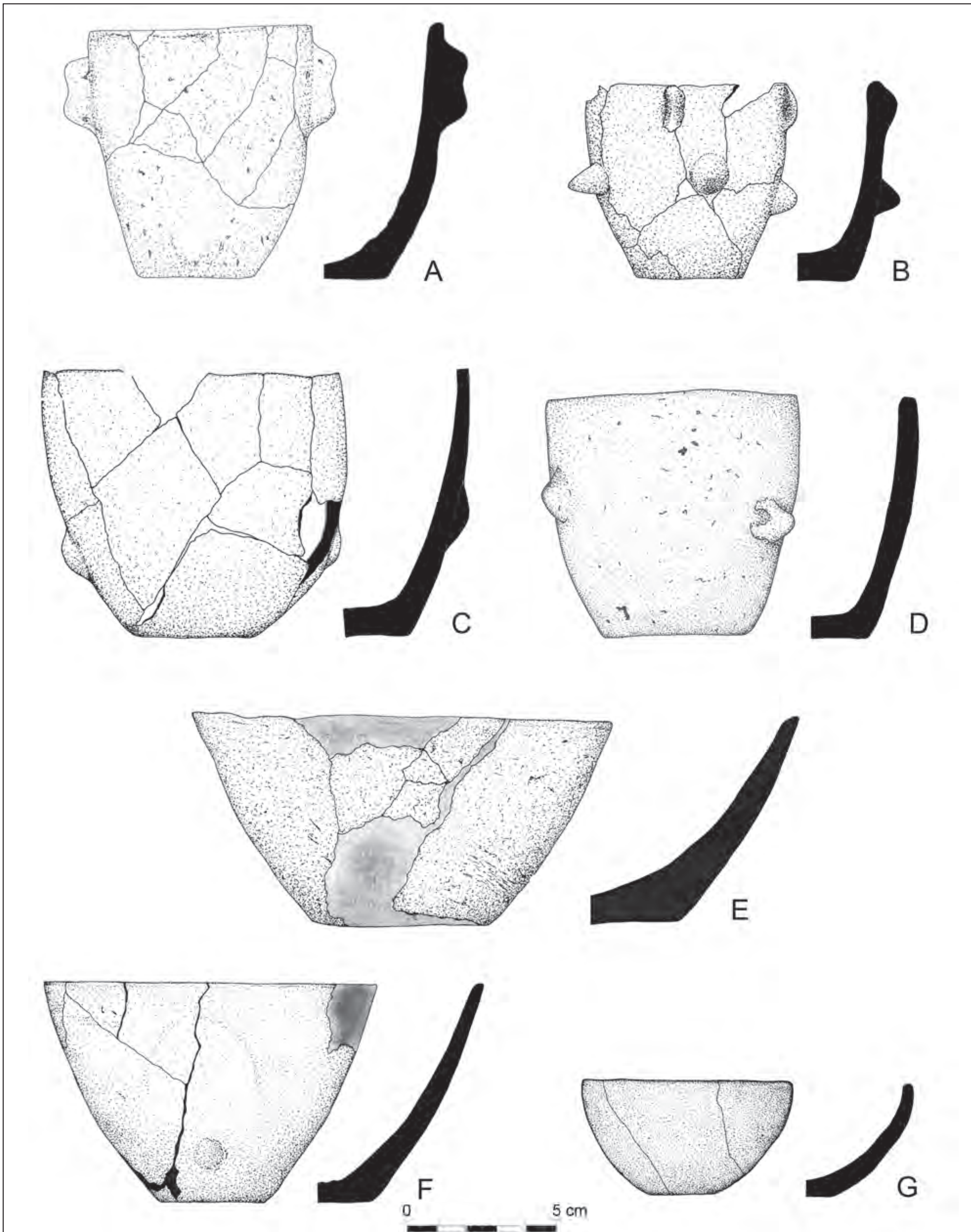


Figure 9.3. Mugs with convex or conical profiles (Type 1.A) from Vésztő-Bikeri (A–D, G) and Körösladány-Bikeri (E, F). A: V20-3-190-12; B: V20-3-156-10; C: V20-3-192-15; D: V20-3-180-14; E: K14-7-064-92; F: K14-7-064-87; G: V20-3-181-52. *Figure by Dorottya Kékegyi and Jill Seagard.*

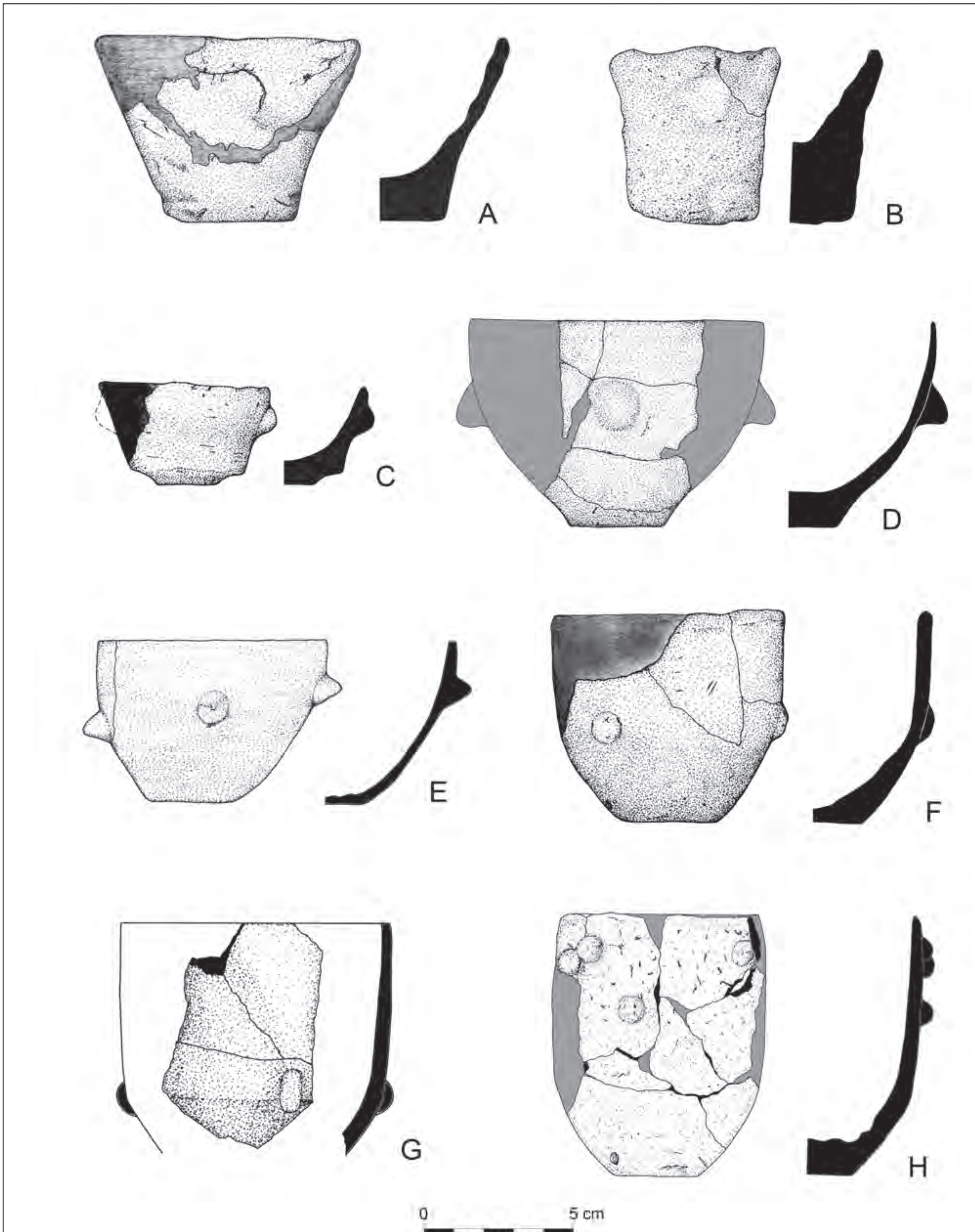


Figure 9.4. Mugs with convex or conical profiles (Type 1.A) from Körösladány-Bikeri (A–C) and mugs with convex or conical lower parts and cylindrical upper sections (Type 1.B) from Vésztő-Bikeri (D, E, G, H) and Körösladány-Bikeri (F). A: K14-7-064-90; B: K14-7-065-3; C: K14-7-064-86; D: V20-5-047-1; E: V20-3-246-5; F: K14-7-064-91; G: V20-2-440-4; H: V20-2-413-57. *Figure by Dorottya Kékegyi and Jill Seagard.*

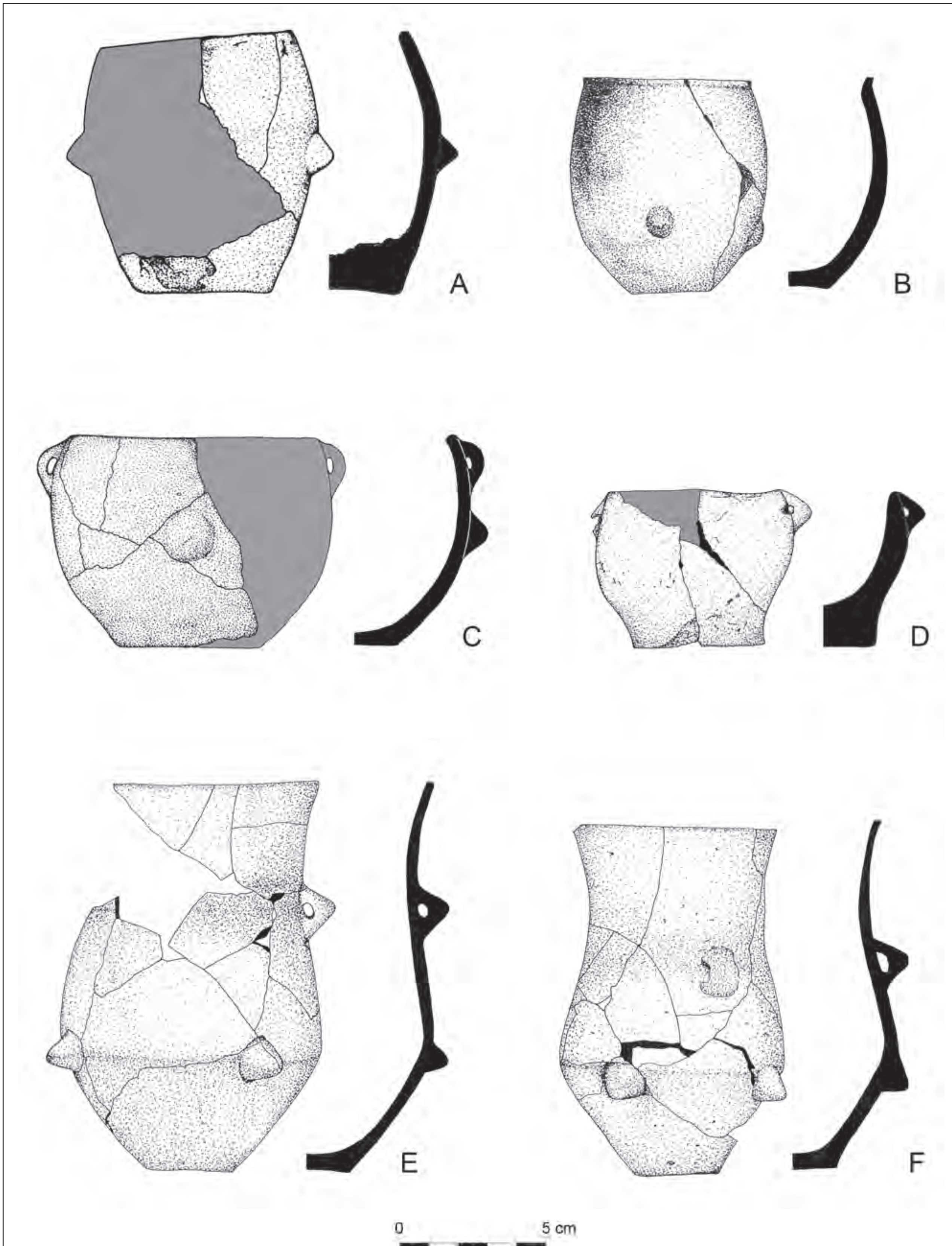


Figure 9.5. Barrel-shaped mugs (Type 1.C) and collared mugs (Type 1.D) from Vésztő-Bikeri. A: V20-2-432-69; B: V20-2-002-30; C: V20-3-181-54; D: V20-3-057-16; E: V20-2-143-205; F: V20-2-143-204. *Figure by Dorottya Kékegyi and Jill Seagard.*

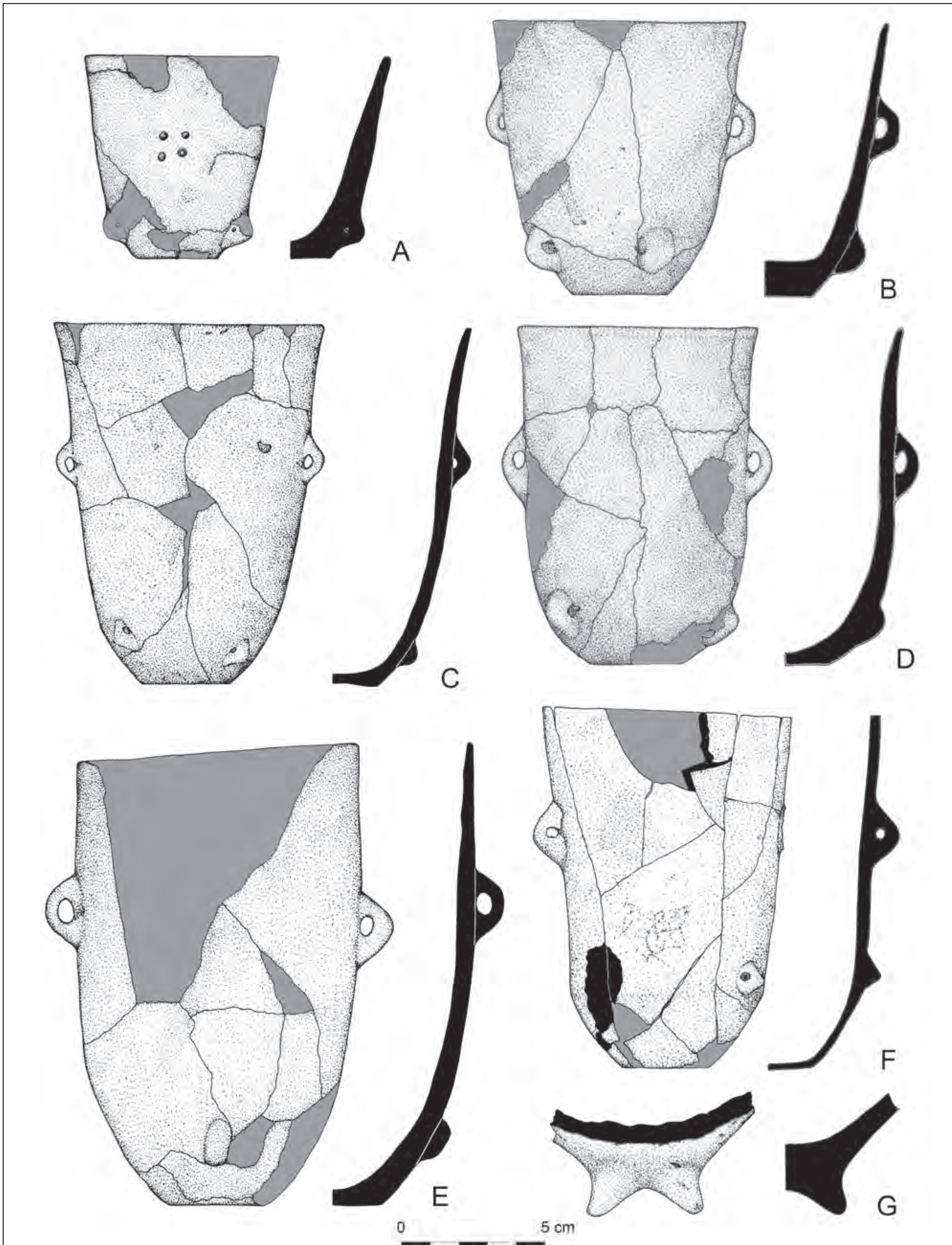


Figure 9.6. Tumblers (Type 1.E) from Vésztő-Bikeri (F, G) and Körösladány-Bikeri (A–E). A: K14-5-048-1; B: K14-5-127-2; C: K14-5-127-3; D: K14-5-127-1; E: K14-6-027-11; F: V20-3-246-6; G: V20-2-382-7. *Figure by Dorottya Kékegyi and Jill Seagard.*

Regarding decorations, in each case, the top shoulder has two horizontally perforated, pointed lugs, and four similar but unpierced lugs were attached to the middle section of the body. The collar and body of several of these mugs are decorated with white incrustation in a crosshatched pattern lacking incision. In some cases, traces of a similar decoration technique also are visible around the base of the lugs and at the bottom of the collar.

1.E. Tumblers (Figure 9.6)

In addition to their highly standardized decorations, tumblers are distinguished from mugs with a convex or conical lower part and cylindrical upper section (Type 1.B) in that the cylindrical upper part constitutes more than 70 percent of the body. Two subvariants occur exclusively in the fine, thin-walled group of ceramics in the Bikeri assemblages: 1.E.a: These vessels exhibit a straight or occasionally everted rim, a gently concave upper profile, and—below a sharp break—a short, convex lower body. The height of this subvariant is typically 7 to 12 cm, and the rim diameter ranges between 6 and 8 cm (Figure 9.6A–C; Bognár-Kutzián Type A2). 1.E.b: These tumblers have a cylindrical upper profile. The rim is straight or slightly flaring, and the base is convex. The height of this subvariant ranges from 11 to 17 cm, and the rim diameter from 8 to 10 cm (Figure 9.6D–F; not included in Bognár-Kutzián's typology).

The bottom shoulder of both subvariants commonly is supplied with two horizontally pierced lugs, and in each case, two or four lugs are placed around the base or on the bulge of the lower section. Other decorations are few and include groups of incised dots arranged in triangular or rectangular patterns (Figure 9.6A). Occasionally, the vessel is not flat-bottomed but sits on four lugs attached to the base (Figure 9.6G). Complete specimens were found only in burial contexts at both sites (see Chapters 7 and 16, this volume).

2. Bowls (Figures 9.7–9.15; Bognár-Kutzián Types K–L)

There is enormous variation with regard to the size and shape of bowls in the two Bikeri assemblages. The largest number of identifiable diagnostic sherds from Vésztő-Bikeri are from bowls, and they are the third most common vessel type at Körösladány-Bikeri (Table 9.4). There are 30 complete bowl profiles in the Vésztő-Bikeri and 10 in the Körösladány-Bikeri assemblages. Bowls likely were used as serving vessels. Eight major variants were identified in the assemblages.

2.A. Bowls with convex or conical profiles (Figures 9.7 and 9.8A–C)

This is the most common bowl type at the Bikeri sites. As noted above, an arbitrary value of 15 cm in rim diameter was used to differentiate bowls from mugs. A broad size range occurs among both the fine and coarse wares. Three subvariants were identified in the assemblages: 2.A.a: The convex body narrows steeply and evenly to the base, and the ratio between the diameter of the rim and the vessel height is less than 2 to 1 (Figure 9.7A; not included in Bognár-Kutzián's typology). 2.A.b: The convex body of this proportionally flatter subvariant narrows evenly to the base, and the ratio between the diameter of the rim and the vessel height is more than 2 to 1 (Figures 9.7B–C and 9.8A–C; similar to Bognár-Kutzián K12). 2.A.c: The profile is conical (Figure 9.7D; similar to Bognár-Kutzián Type K13).

The maximum height of these bowls is 20 cm. The rim diameter typically ranges between 15 and 35 cm. However, small, almost miniature specimens also occur in the assemblages (Figure 9.8B–C). Four symmetrically arranged lugs may be attached to the upper or middle section of the vessels (e.g., Figures 9.7C and 9.8B–C), and plastic shelves occasionally were applied along the rim in each subvariant (Figure 9.8A). The rims sometimes are hash-marked or four-tabbed with lugs on the outer surface. A fine, unique specimen shows complex linear incised motifs (Figure 9.36G). Bowls with convex, and less frequently conical, profiles oftentimes occur as upper parts of pedestalled vessels (Figure 9.28A–D).

2.B. Bowls with convex or conical lower parts and cylindrical upper sections (Figures 9.8D–F and 9.9A–C)

The vast majority of the specimens of this common vessel type are fine wares, but large vessels also are present among the coarse wares. Based on rim shape, two subvariants were defined: 2.B.a: Bowls with an upright rim (Figure 9.8D–F; Bognár-Kutzián Types K2 and L1). 2.B.b: Bowls with a markedly everted rim (Figure 9.9A–C; similar to Bognár-Kutzián Type K2k).

The size range of these vessels is similar to that of the bowls with a convex or conical profile (Type 2.A), and the ratio between the height of the lower and upper sections is diverse. Four lugs of various shapes frequently were placed on the bulge between the upper and lower parts or slightly underneath (e.g., Figure 9.8F). The fine examples are always well burnished on both the interior and exterior and commonly are decorated with groups, a single row, or multiple horizontal and zigzag rows of incised dots, as well as linear incisions on the cylindrical upper part (e.g., Figures 9.8D, 9.9C, 9.36D).

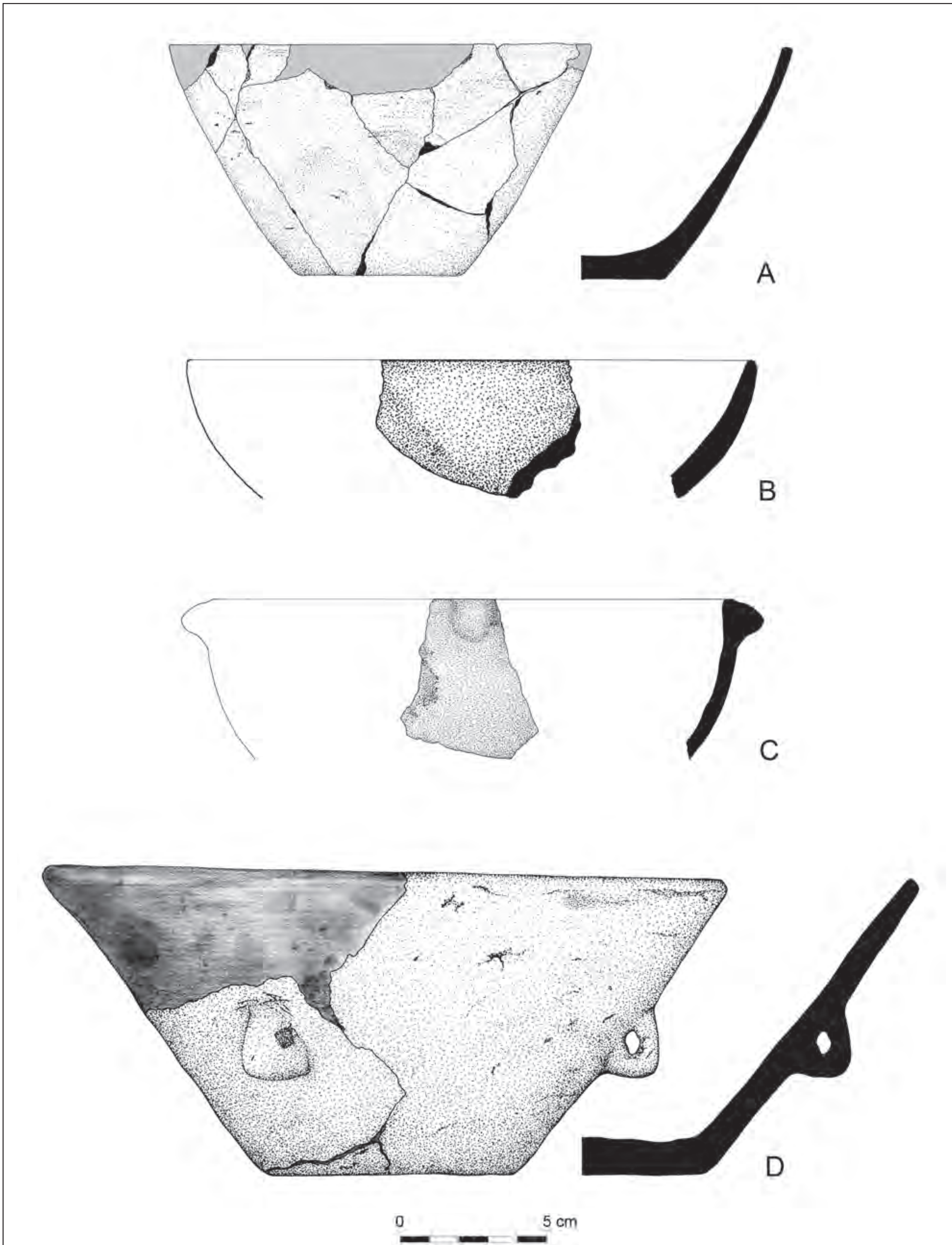


Figure 9.7. Bowls with convex or conical profiles (Type 2.A) from Vésztő-Bikeri (A) and Körösladány-Bikeri (B–D). A: V20-3-002-17; B: K14-7-008-3; C: K14-6-027-4; D: K14-7-064-95. *Figure by Dorottya Kékegyi and Jill Seagard.*

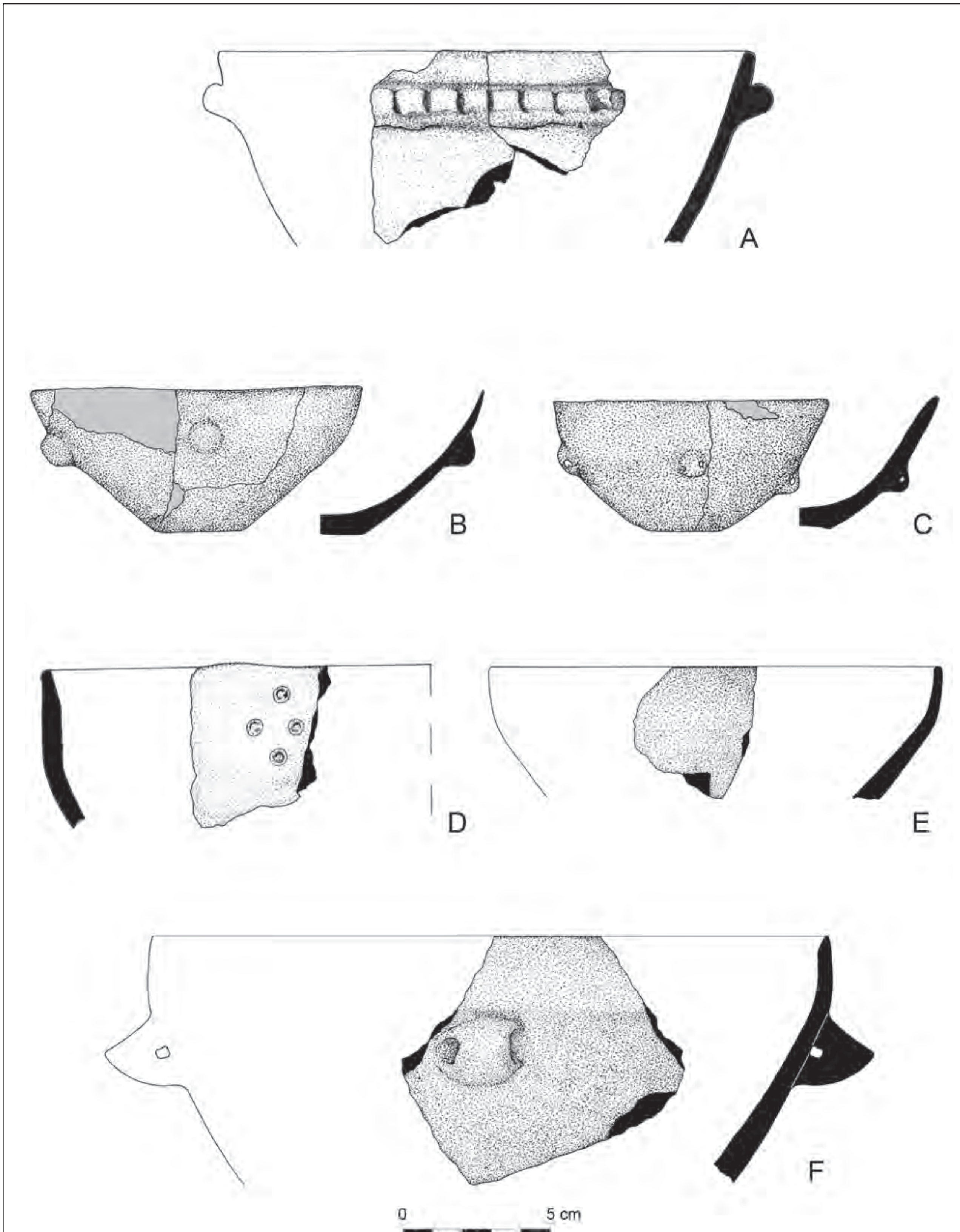


Figure 9.8. Bowls with convex or conical profiles (Type 2.A) from Vésztő-Bikeri (A, C) and Körösladány-Bikeri (B) and bowls with convex or conical lower parts and cylindrical upper sections (Type 2.B) from Vésztő-Bikeri (D) and Körösladány-Bikeri (E, F). A: V20-2-212-10; B: K14-4-039-9; C: V20-7-058-21; D: V20-9-064-189; E: K14-5-002-6; F: K14-5-066-1. *Figure by Dorottya Kékegyi and Jill Seagard.*

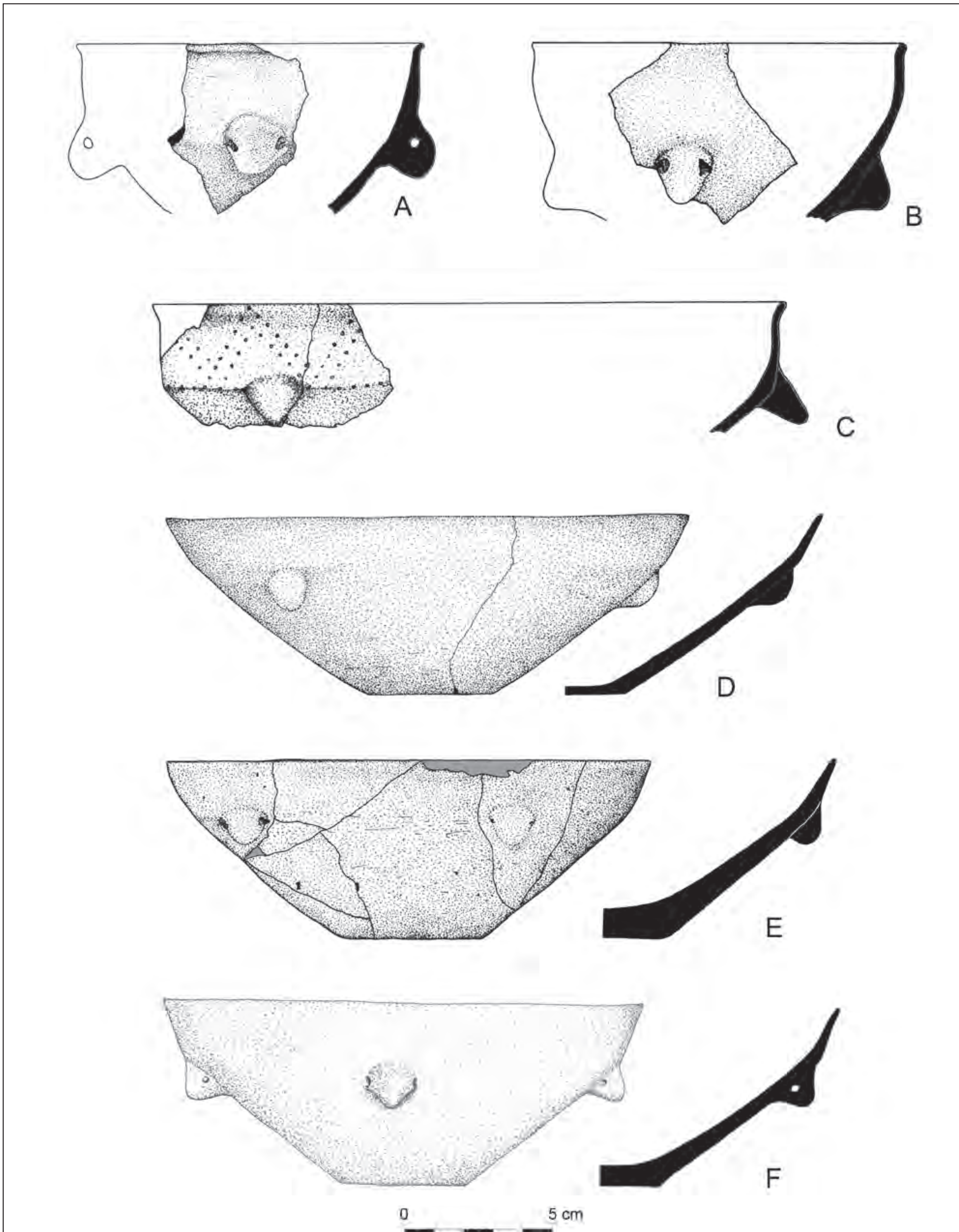


Figure 9.9. Bowls with convex or conical lower parts and cylindrical upper sections (Type 2.B) from Vésztő-Bikeri (A–C) and bowls with convex or conical lower parts and everted upper sections (Type 2.C) from Vésztő-Bikeri (E, F) and Körösladány-Bikeri (D). A: V20-9-063-20; B: V20-9-057-63; C: V20-2-121-2; D: K14-7-064-96; E: V20-3-173-59; F: V20-3-156-9. *Figure by Dorottya Kékegyi and Jill Seagard.*

2.C. Bowls with convex or conical lower parts and everted upper sections (Figures 9.9D–F and 9.10–9.11)

These bowls are present in large numbers among the fine wares of both Bikeri ceramic assemblages and to a limited degree in the coarse ware group. The vessel type has two subvariants: 2.C.a: Bowls with a conical upper part and a straight everted rim (Figures 9.9D–F, 9.10A–C, 9.11A; not included in Bognár-Kutzián's typology). 2.C.b: Bowls with a flaring upper section, where the profile commonly shows an elongated S shape (Figures 9.10D–I and 9.11B; similar to Bognár-Kutzián Type K2j).

These bowls are similar in size to bowls with a convex or conical profile (Type 2.A), and the ratio between the height of the lower and upper vessel sections varies. Like the bowls with a cylindrical upper section (Type 2.B), decorative elements include four symmetrically arranged lugs of various shapes on the bulge or below (e.g., Figure 9.9D–F), as well as incised dots in linear fashion or in groups (Figure 9.10H). A Type 2.C.a and a Type 2.C.b bowl from Block 3 at Vésztő-Bikeri are lavishly ornamented with complex incised linear patterns (Figure 9.11).

2.D. Bowls with flaring profiles (Figure 9.12; Bognár-Kutzián Type K11)

The size of these vessels is variable, but the rim diameter of the more typical large specimens ranges between 37 and 42 cm, and their height is about 15 cm. The thick wall is burnished both on the interior and exterior. Four large, ovate, semi-pointed or pointed, horizontally pierced lugs are located in the middle section of the flaring body. Additional decorations may include groups of three or four large incised dots on the interior or exterior. An infant burial at Körösladány-Bikeri (Feature 12) was covered with a deliberately broken bowl of this type (Figure 9.12A; see Chapters 7 and 16, this volume).

2.E. Flat bowls (Figure 9.13)

These round, ovate, or rarely rectangular vessels have two subvariants: 2.E.a: Bowls with vertical walls (Figure 9.13A–C; Bognár-Kutzián Type K4). 2.E.b: Bowls with everted walls and a conical profile (Figure 9.13D–E; not included in Bognár-Kutzián's typology). Both subvariants have short and thick walls and occur exclusively among the coarse wares. The height of the six complete profiles in the Bikeri assemblages ranges between 5 and 7 cm, with an exceptional example that is 10 cm high. The exterior tends to be decorated with large lugs (Figure 9.13C), the rim is occasionally hash-marked or finger-impressed (Figure 9.13A). One object has a rough handle, stretching from the rim to the base (Figure 9.13A).

2.F. Rectangular bowls on straight runner legs (Figure 9.14; not included in Bognár-Kutzián's typology)

A rectangular, thick-walled, flat bowl with everted walls and rounded corners constitutes the upper part of these vessels, placed on solid, straight runner legs. The fragments of the vessel type were recovered in relatively large numbers at Vésztő-Bikeri (n = 61), particularly in Blocks 3 and 9, but only two specimens were found at Körösladány-Bikeri. Based on a partially reconstructed bowl, the width of these vessels was about 40 cm (Figure 9.14A). The interior of the bowl part sometimes was decorated with shallow plastic, curvilinear, and garland channel motifs (Figure 9.14B), while short hash marks occur on the rim and legs in several other cases. Dotted incisions are present on a single leg fragment. Large lugs may have been placed on each corner of the bowls. Because all fragments were found in secondary depositional contexts at the Bikeri sites, the function of these ceramics remains uncertain.

2.G. Biconical bowls (Figure 9.15A–C; similar to Bognár-Kutzián Type K2i)

This is one of the two closed bowl types in the Bikeri assemblages. These rare vessels typically occur among the fine wares at both sites. Complete profiles were not found. The rim diameter measures 15 to 25 cm, commonly 17 to 20 cm. The break between the two truncated cones of the body may be markedly sharp or rounded off. Four symmetrically arranged lugs of various shapes may be located in the upper section, on the bulge, or on the lower part of the vessel. Rows and groups of incised dots occur predominantly in the upper section and sometimes on the lower part as well. Hash-marked plastic shelves also are found occasionally on these vessels.

2.H. Globular bowls (Figure 9.15D–F; similar to Bognár-Kutzián Type K3b)

This closed vessel type has a globular body with an inverted upper profile and a markedly everted, short rim. Less than 15 fragments were identified at the Bikeri sites, and no complete profiles are present in the assemblages. The rim diameter ranges from 15 to 30 cm, and the decorated objects exhibit lugs and incised dotted motifs in the middle section of the body. Several of these bowl fragments may have belonged to pedestalled bowls (see Figure 9.29E–F).

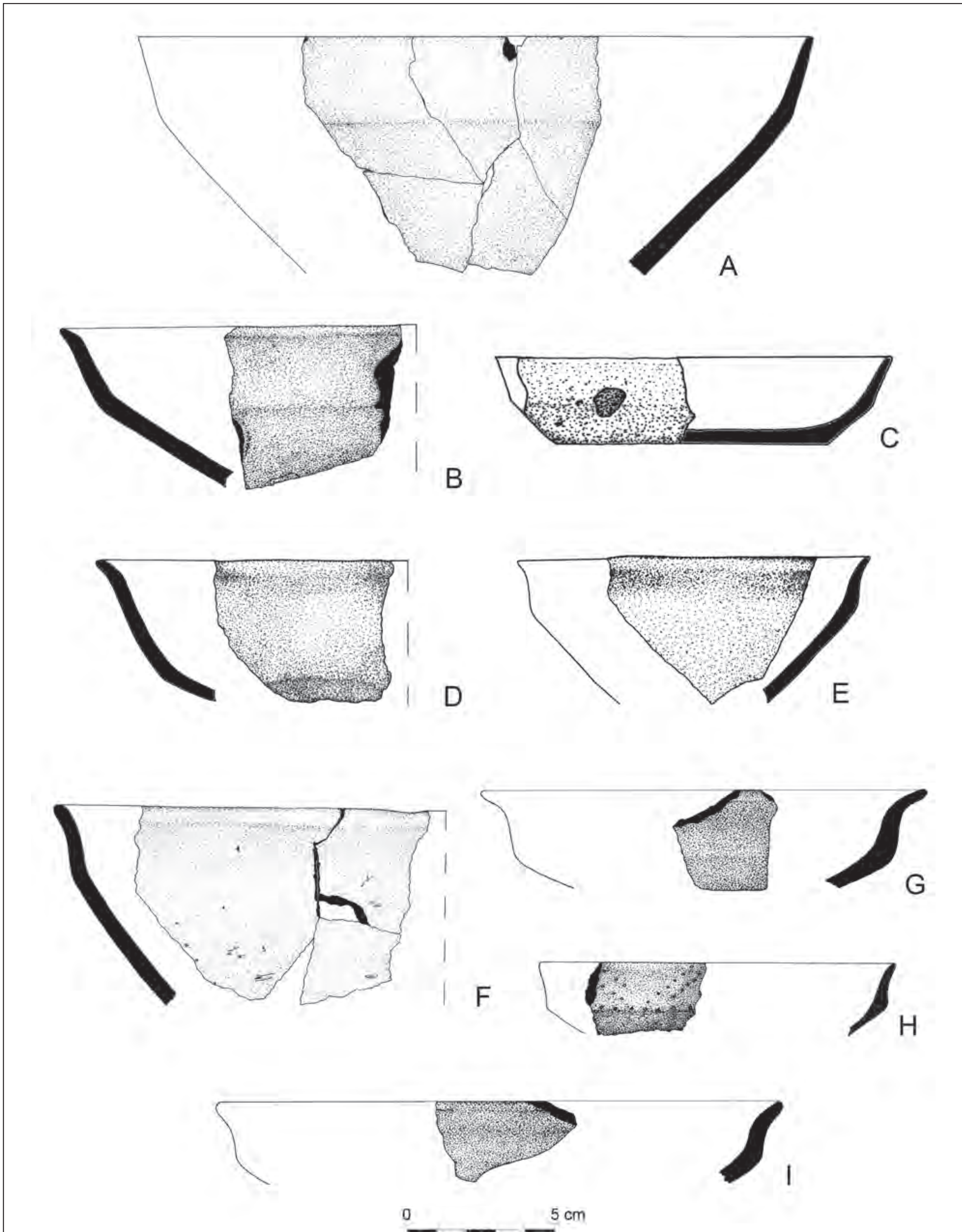


Figure 9.10. Bowls with convex or conical lower parts and everted upper sections (Type 2.C) from Vésztő-Bikeri (A–F, H) and Körösladány-Bikeri (G, I). A: V20-3-052-1; B: V20-7-133-80; C: V20-2-442-8; D: V20-9-060-111; E: V20-9-114-1; F: V20-9-060-2; G: K14-4-009-36; H: V20-2-277-1; I: K14-5-117-8. *Figure by Dorottya Kékegyi and Jill Seagard.*

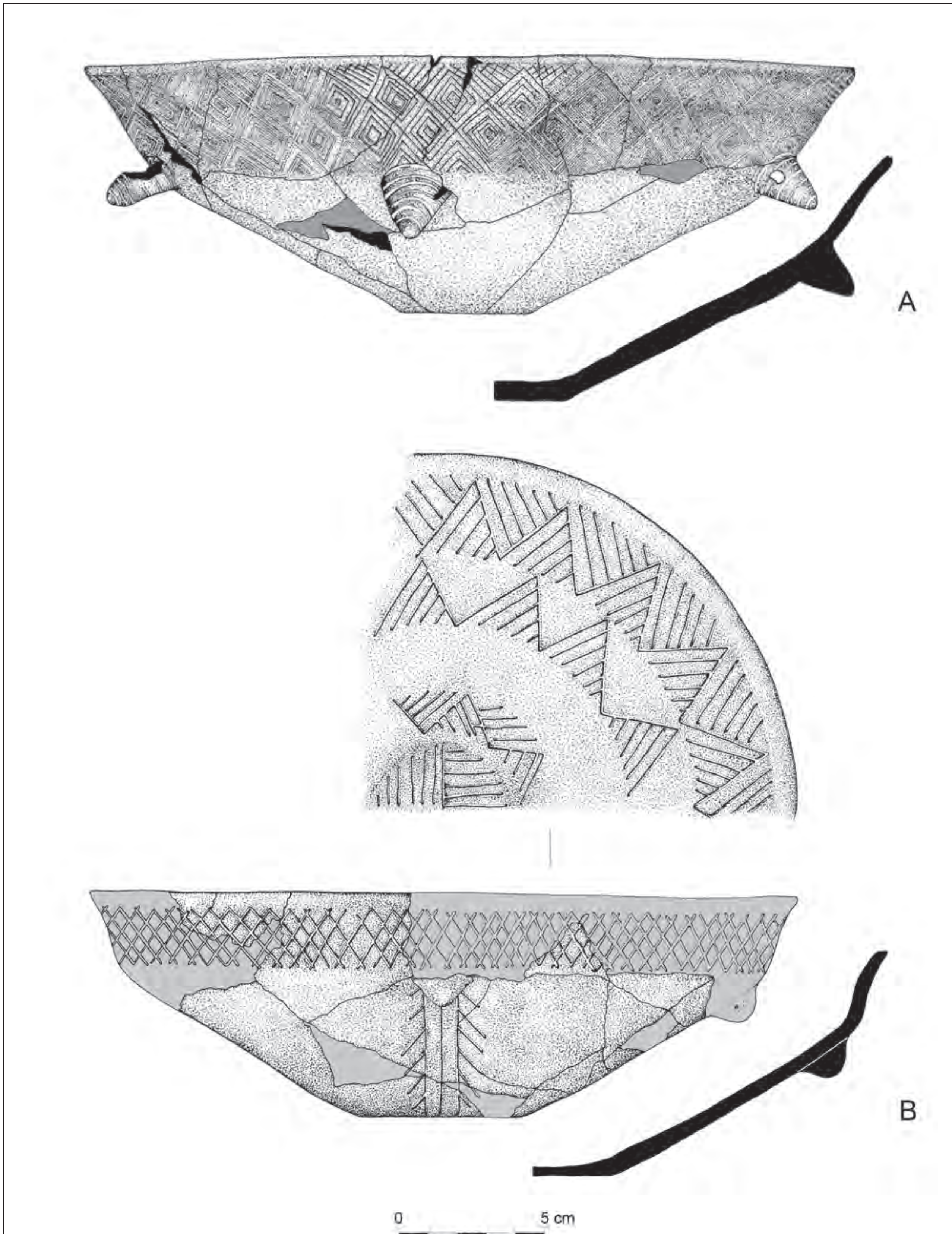


Figure 9.11. Bowls with convex or conical lower parts and everted upper sections (Type 2.C) from Vésztő-Bikeri. A: V20-3-064-87; B: V20-3-183-63. *Figure by Dorottya Kékegyi and Jill Seagard.*

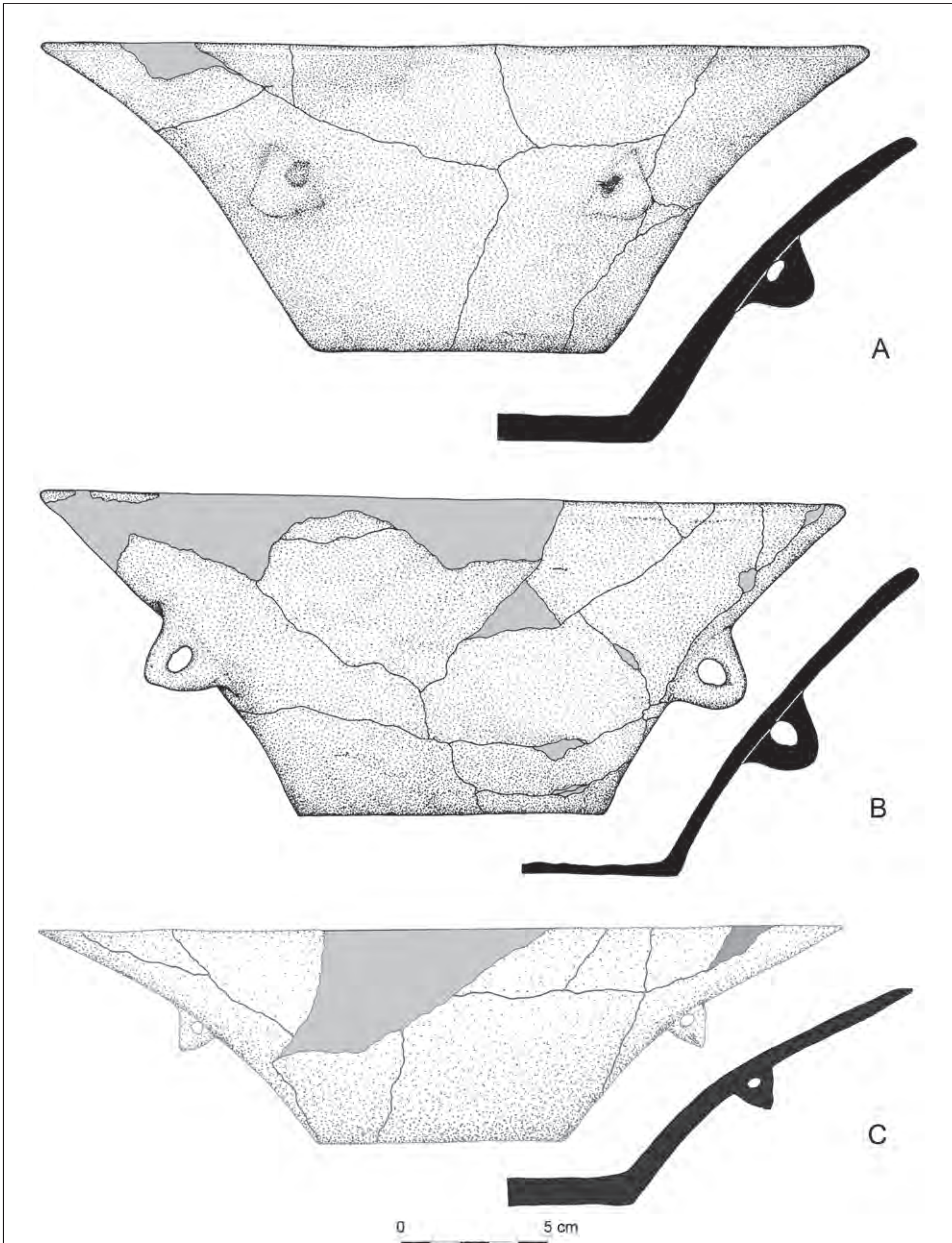


Figure 9.12. Bowls with flaring profiles (Type 2.D) from Vésztő-Bikeri (B, C) and Körösladány-Bikeri (A). A: K14-4-061-1; B: V20-3-173-65; C: V20-3-173-67. *Figure by Dorottya Kékegyi and Jill Seagard.*

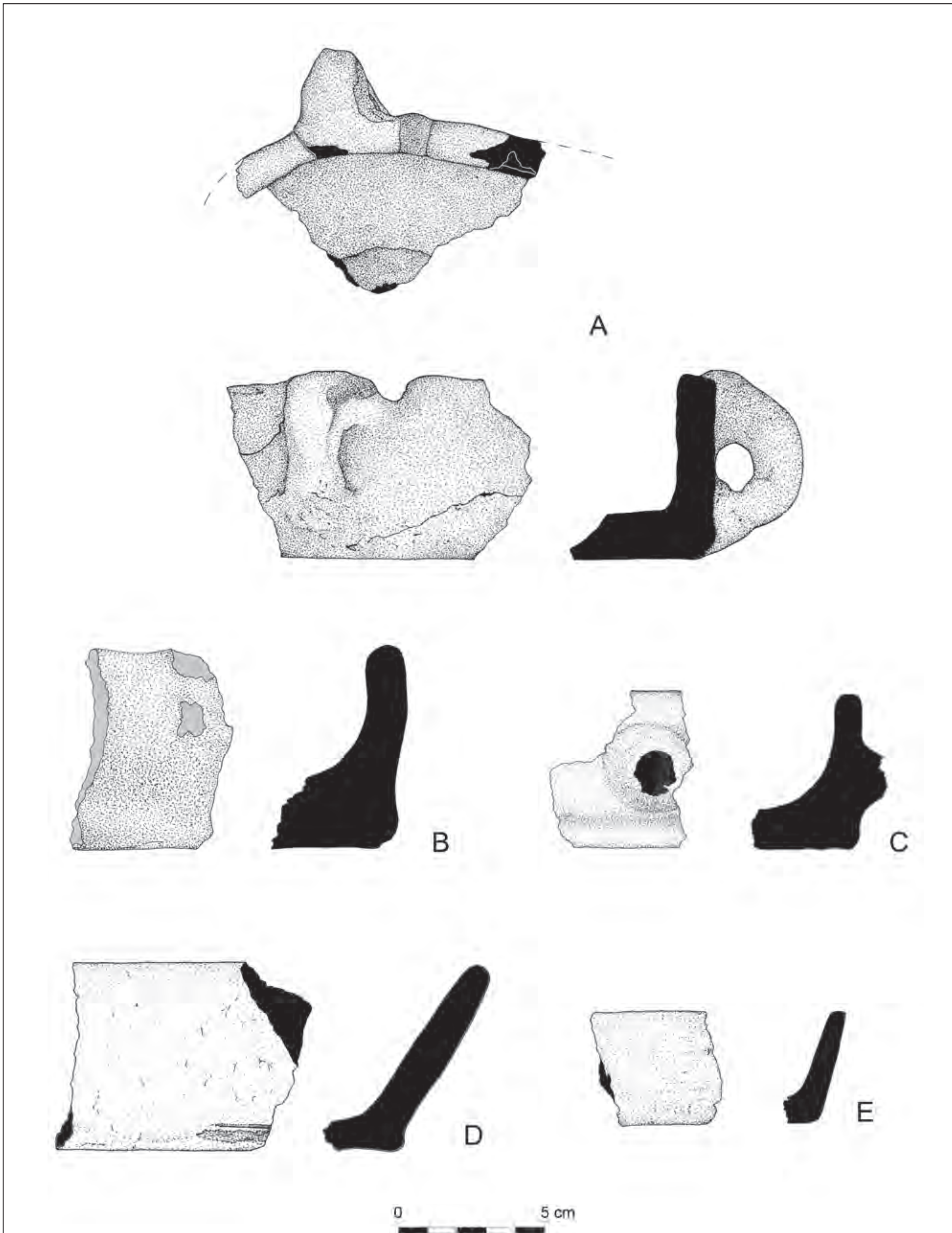


Figure 9.13. Flat bowls (Type 2.E) from Vésztő-Bikeri (B–E) and Körösladány-Bikeri (A). A: K14-3-077-1; B: V20-7-040-5; C: V20-7-004-27; D: V20-9-115-107; E: V20-7-055-15. *Figure by Dorottya Kékegyi and Jill Seagard.*

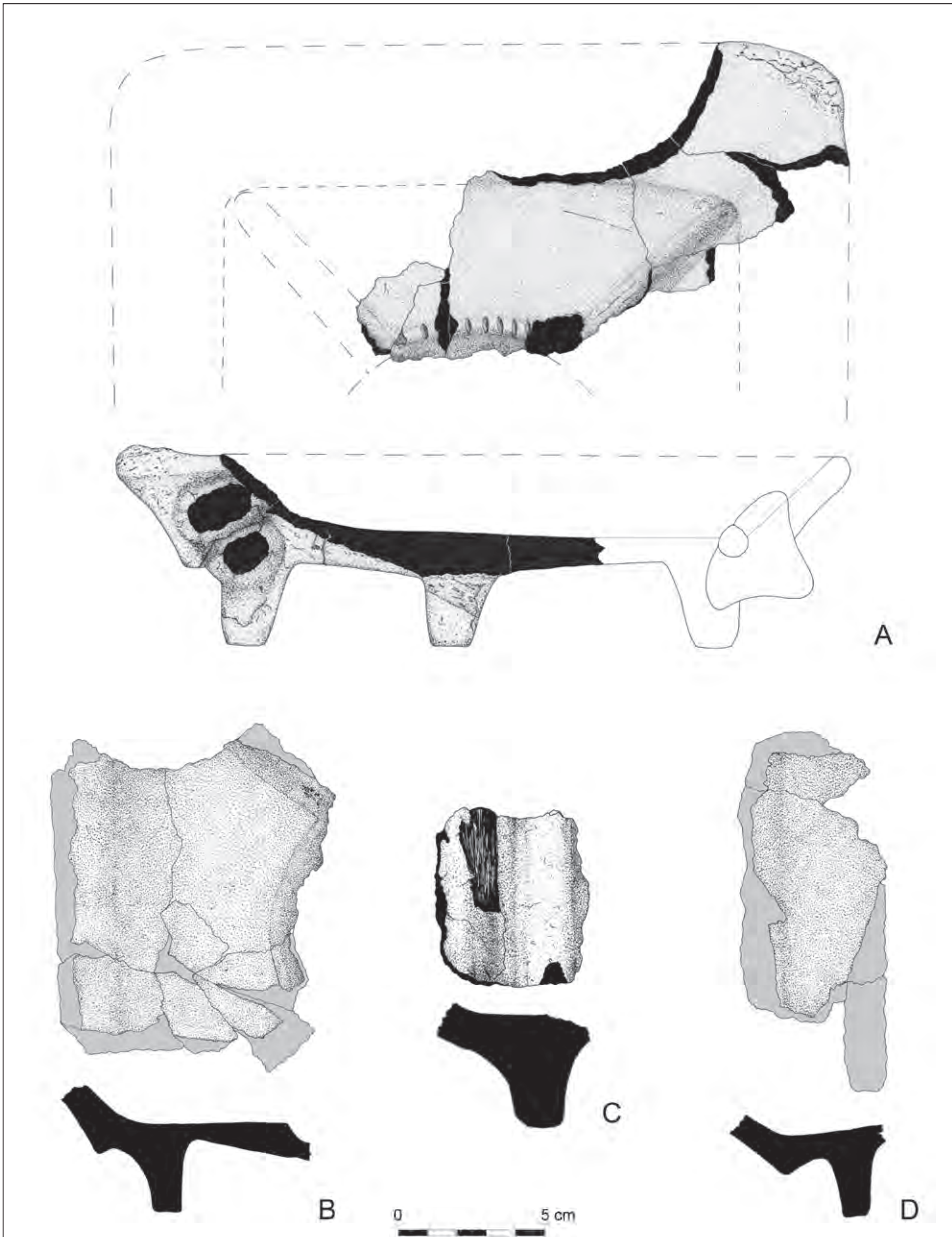


Figure 9.14. Rectangular bowls on straight runner legs (Type 2.F) from Vésztő-Bikeri. A: V20-9-076-8; B: V20-9-169-1; C: V20-2-236-1; D: V20-4-001-15. *Figure by Dorottya Kékegyi and Jill Seagard.*

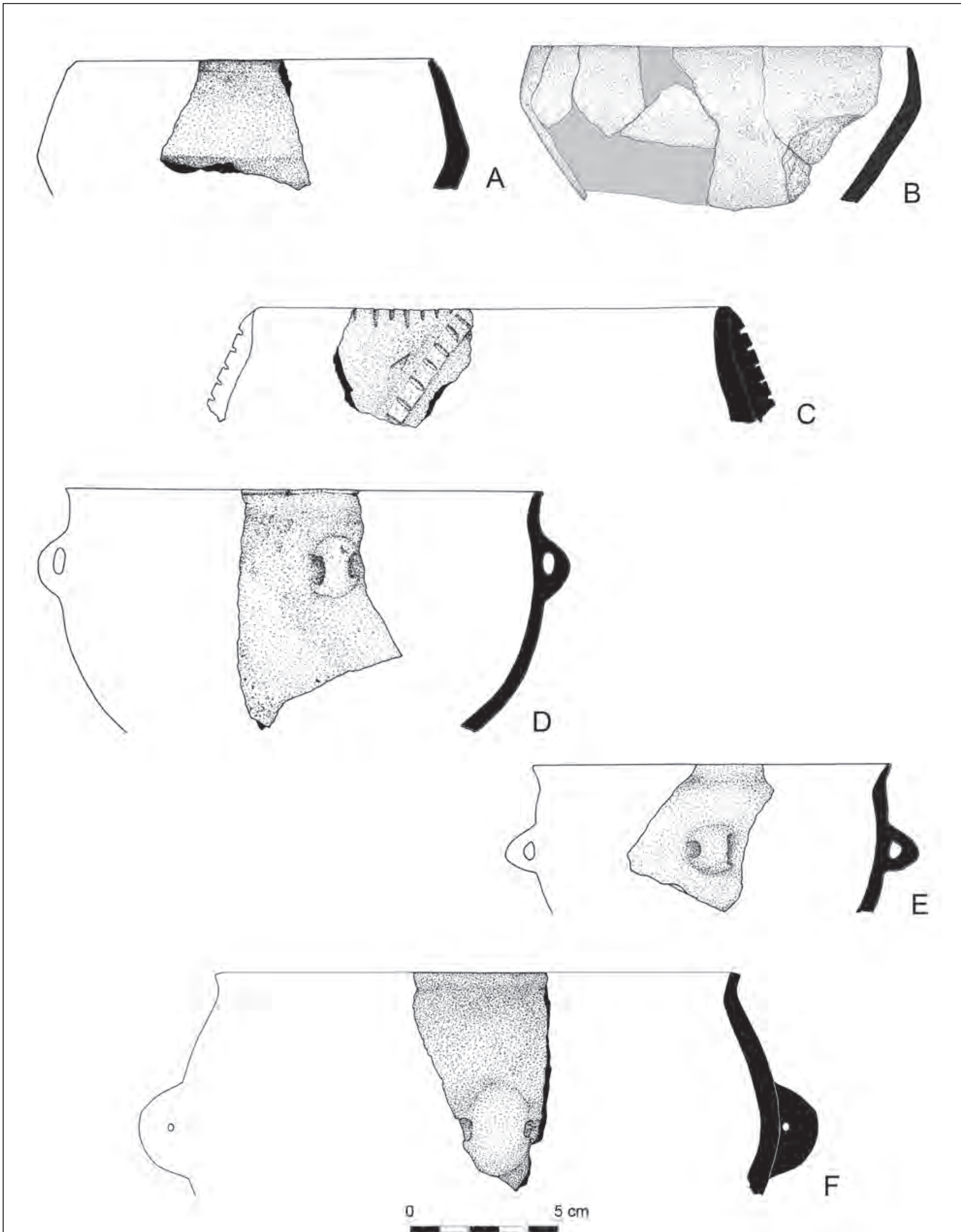


Figure 9.15. Biconical bowls (Type 2.G) from Vésztő-Bikeri (A, C) and Körösladány-Bikeri (B) and globular bowls (Type 2.H) from Vésztő-Bikeri (D, E) and Körösladány-Bikeri (F). A: V20-7-042-18; B: K14-7-055-291; C: V20-7-052-135; D: V20-2-415-2; E: V20-9-101-18; F: K14-3-028-1. *Figure by Dorottya Kékegyi and Jill Seagard.*

3. Pots (Figures 9.16–9.22; Bognár-Kutzián Types B–C)

Sherds from pots ranked second at Vésztő-Bikeri, and fourth in the Körösladány-Bikeri assemblage (Table 9.4). Pots are distinguished from mugs of similar shapes by a height that exceeds 13 cm or—when height data is unavailable—by a rim diameter that exceeds 10 cm. There are 10 examples with a complete profile in both the Vésztő-Bikeri and Körösladány-Bikeri assemblages. Pots may have had several functions. Most of the coarser specimens probably were cooking and storage vessels, while the finer examples also may have been used for serving. Five major variants were identified in the Bikeri assemblages.

3.A. Pots with convex or conical profiles (Figures 9.16–9.18)

This is the most common variant in the group of coarse vessels at both sites, but some examples are found among the fine wares as well. In morphological terms, these pots resemble mugs with convex or conical profiles (Type 2.A). Three subvariants are present in the Bikeri assemblages: 3.A.a: The rim is straight or occasionally slightly everted, and below that there is a nearly vertical shoulder section. The stocky body is convex. The rim diameter exceeds the vessel height (Figures 9.16–9.17; Bognár-Kutzián Type C1). 3.A.b: The rim is straight, and the convex and slender body steeply narrows to the base. The vessel height exceeds the diameter of the rim. This is a rare vessel type in the Bikeri assemblages (Figure 9.18A; not included in Bognár-Kutzián's typology). 3.A.c: The profile is conical (Figure 9.18B; not included in Bognár-Kutzián's typology).

The size range of these pots is fairly broad; their height—as well as their rim diameter—commonly ranges between 13 and 30 cm, but larger specimens also were used at the Bikeri sites. Two to four lugs of various types and sizes, sometimes vertically placed and occasionally in pairs, were attached to the rim and/or the shoulder. An alternating set of lugs frequently was applied in the middle section or at the lower part of the body (e.g., Figure 9.17A). The lug arrangement is usually symmetrical but occasionally haphazard. A row of small knobs also may occur below the rim. The rims may be hash-marked or rarely finger-impressed (e.g., Figure 9.18B). In several cases, horizontal or diagonal hash-marked plastic shelves are found at the top of the shoulder (e.g., Figure 9.32G–I). Some fine specimens are decorated with one row, two rows, or groups of incised dots in the upper sections. The two to four dots that occur in groups at the rim or on the shoulder—spatially associated with the lugs—are wide, shallow, and not incrusted. At Körösladány-Bikeri, an infant burial (Feature 11) was covered with large pieces of a deliberately broken Type 3.A.a pot (Figure 9.17B; see Chapters 7 and 16, this volume).

3.B. Pots with convex or conical lower parts and everted upper sections (Figure 9.19; not included in Bognár-Kutzián's typology)

The convex or conical lower part continues into a funnel-shaped everted collar above a more or less sharp bulge. Fragments of this vessel type were identified in a small number in the Bikeri assemblages, and only one vessel with a complete profile was reconstructed from each site; their heights are 24 and 29 cm. These vessels were decorated similarly to pots with a convex or conical profile (Type 3.A), along with vertically placed lugs on the bulge or on the collar.

3.C. Pots with lug-spouts (Figure 9.20; not included in Bognár-Kutzián's typology)

This vessel type has a straight rim to which pairs of nearly beaked, vertically pierced lug-spouts were attached opposite each other. Complete vessel profiles were not recovered from the Bikeri sites, but based on the available fragments, the body might have been convex in each case. The measurable rim diameters range between 10 and 30 cm, typically 15 to 23 cm. This ceramic type is present exclusively among the fine wares, and they may have been cooking or serving vessels. Decorations do not occur on these artifacts.

3.D. Barrel-shaped pots (Figures 9.21–9.22; Bognár-Kutzián Types C2 and C3a–c)

These closed vessels are characterized by their globular profiles and inverted rims, similar to barrel-shaped mugs (Type 1.C). Based on the proportion of vessel height and width, stocky and slender specimens are present in both the course and fine ware groups of the Bikeri assemblages. The height of complete profiles ranges between 13 and 28 cm, and the rim diameter falls between 11 and 17 cm. Several fragments are from pots with rim diameters of more than 30 cm, indicating that some were very large, more than 40 cm high. Two to four lugs were placed at the rim, on the shoulder, and/or in the middle section of the vessels. Other than lugs, decoration does not occur on barrel-shaped pots.

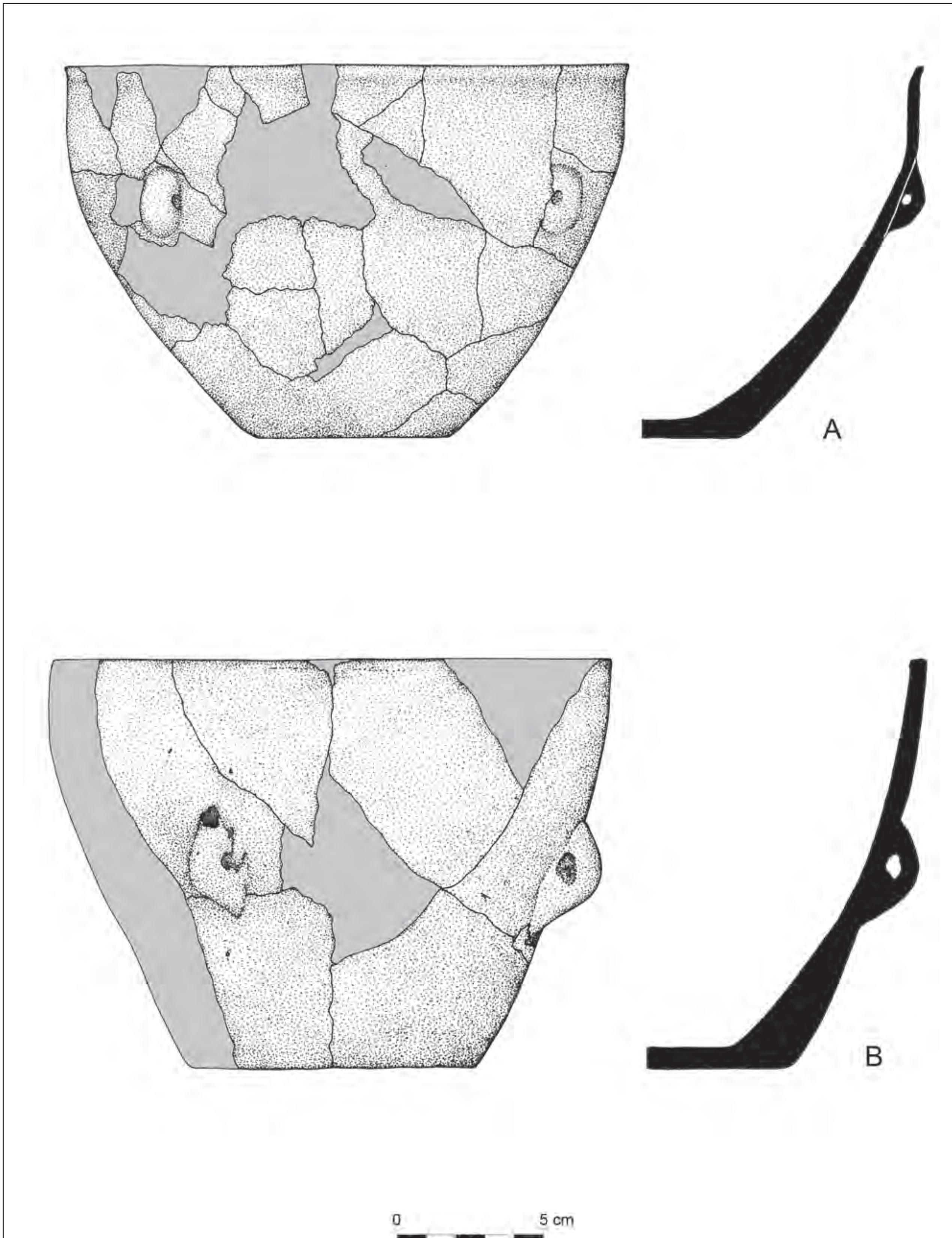


Figure 9.16. Pots with convex or conical profiles (Type 3.A) from Vésztő-Bikeri. A: V20-3-192-23; B: V20-2-167-1. *Figure by Dorottya Kékegyi and Jill Seagard.*

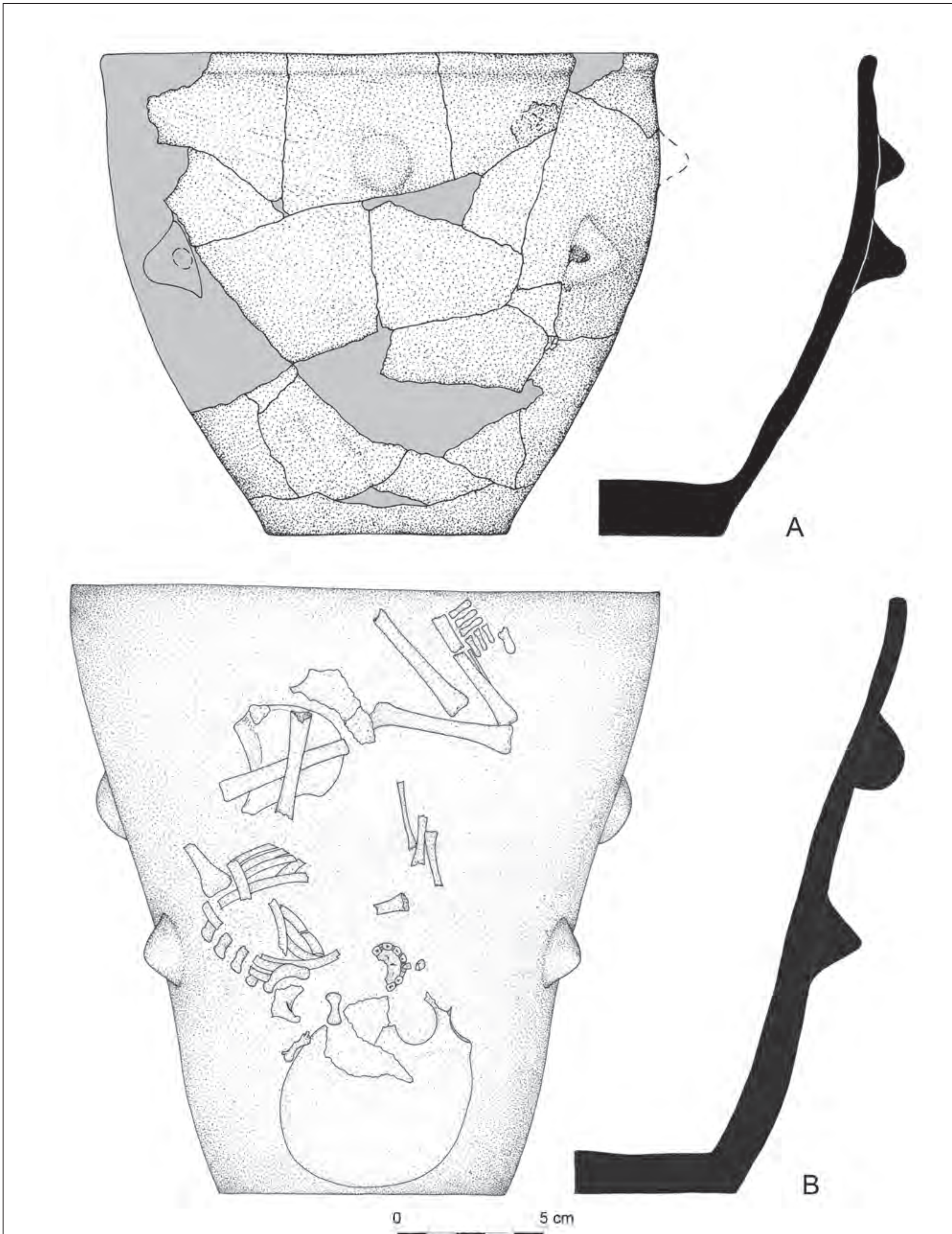


Figure 9.17. Pots with convex or conical profiles (Type 3.A) from Vésztő-Bikeri (A) and Körösladány-Bikeri (B). A: V20-2-167-35; B: K14-4-060-1. Note that the pot from Körösladány-Bikeri covered an infant burial. *Figure by Dorottya Kékegyi and Jill Seagard.*

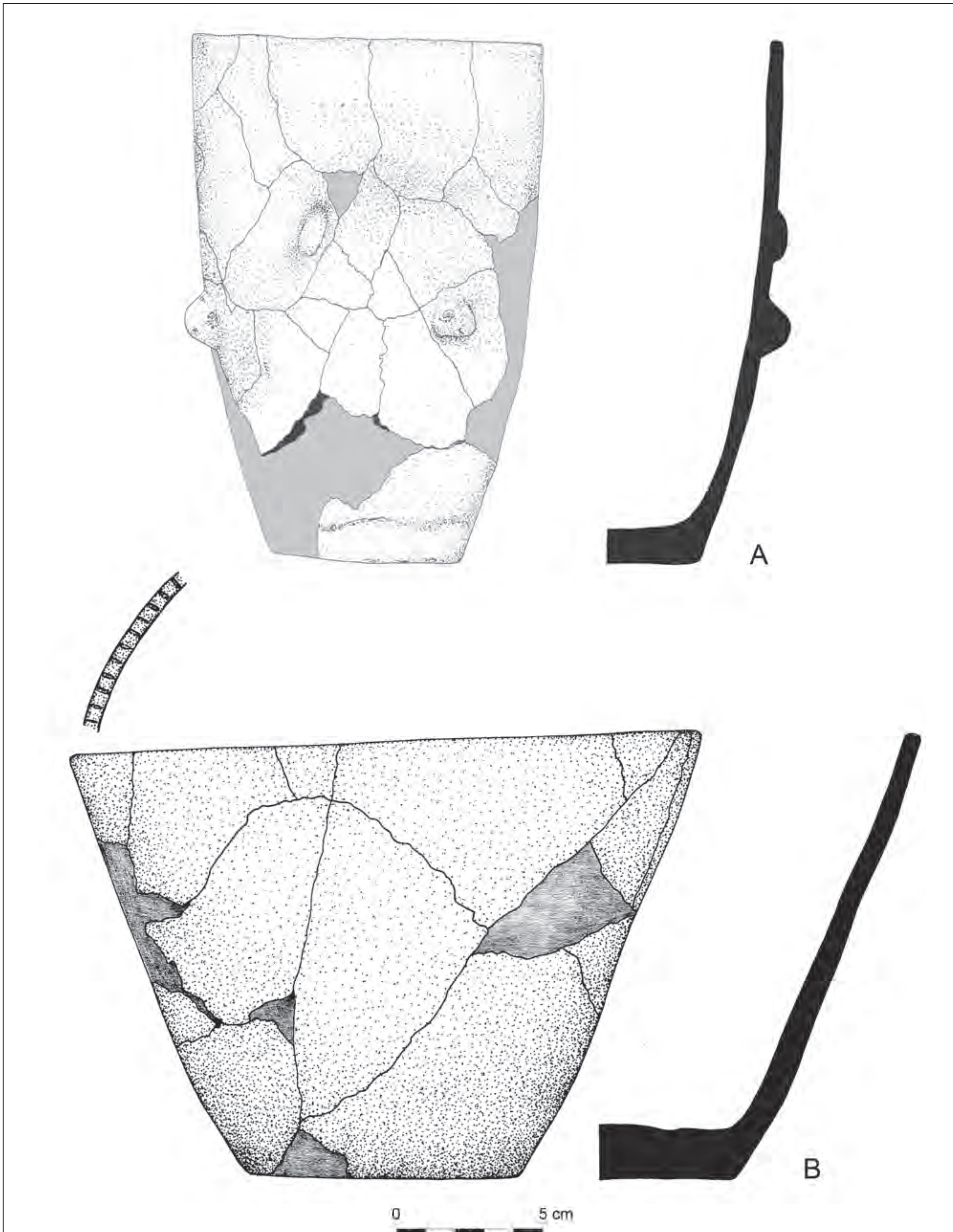


Figure 9.18. Pots with convex or conical profiles (Type 3.A) from Vésztő-Bikeri (A) and Körösladány-Bikeri (B). A: V20-3-172-19; B: K14-7-064-93. *Figure by Dorottya Kékegyi and Jill Seagard.*

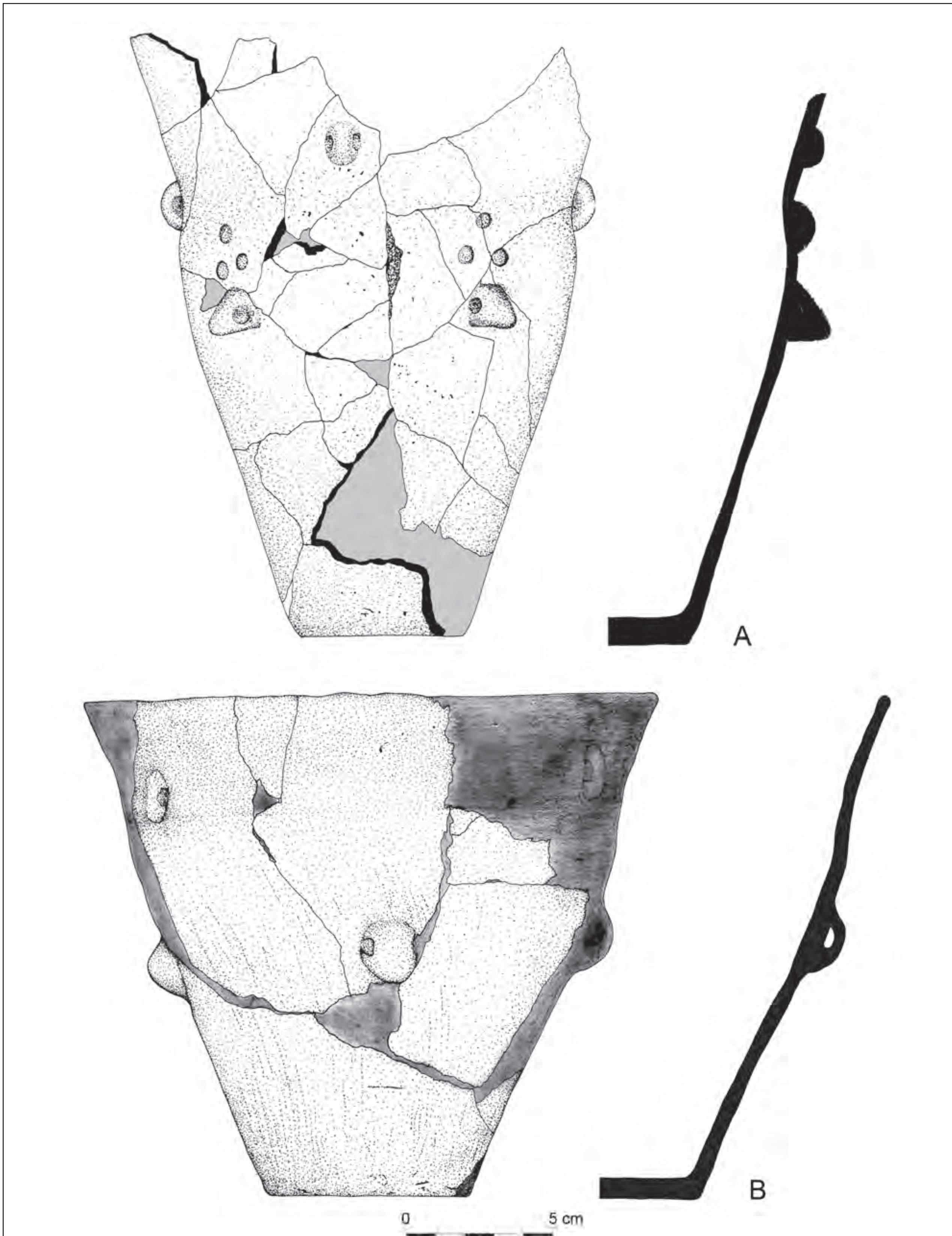


Figure 9.19. Pots with convex or conical lower parts and everted upper sections (Type 3.B) from Vésztő-Bikeri (A) and Körösladány-Bikeri (B). A: V20-3-175-98; B: K14-7-064-94. *Figure by Dorottya Kékegyi and Jill Seagard.*

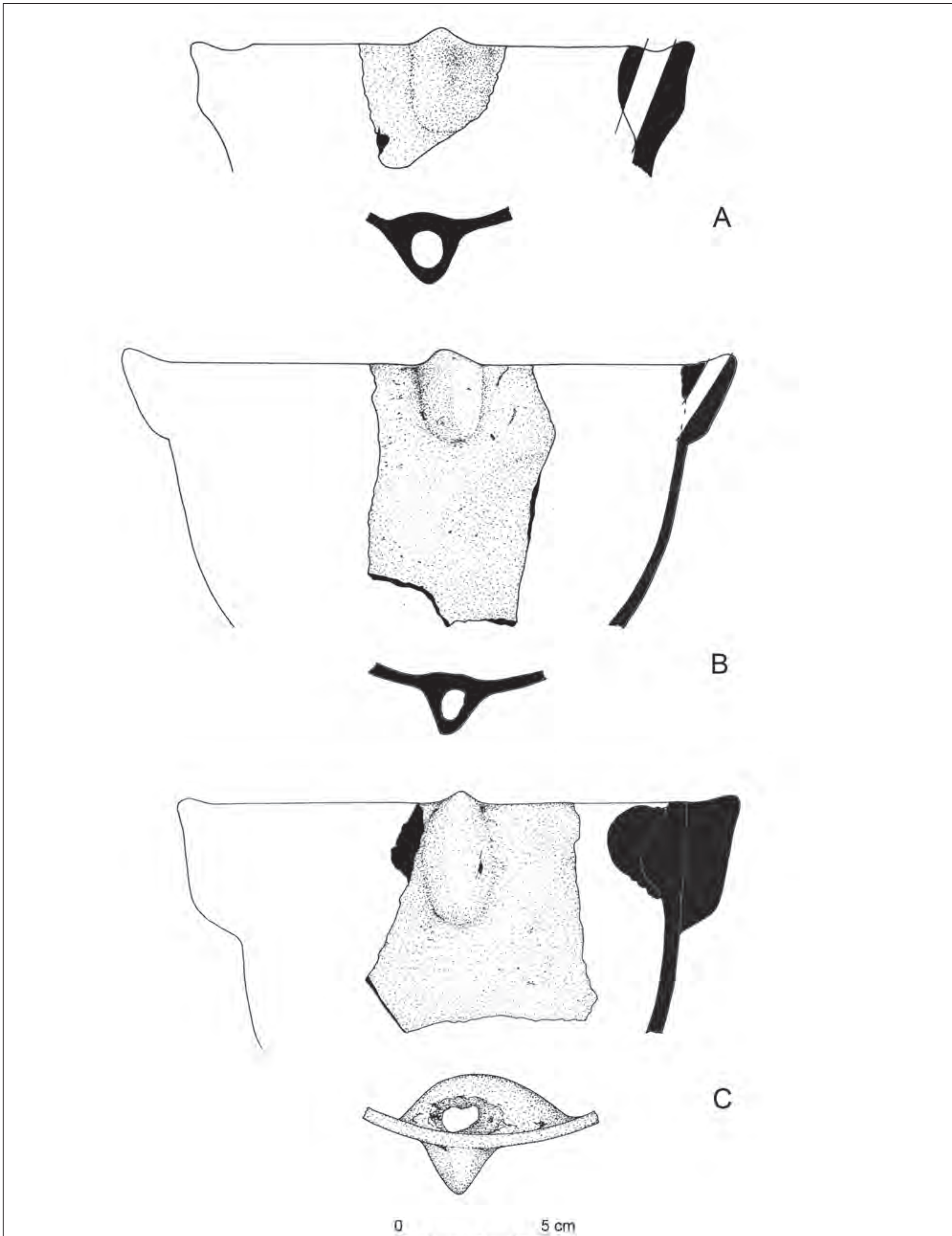


Figure 9.20. Pots with lug-spouts (Type 3.C) from Vésztő-Bikeri. A: V20-9-068-74; B: V20-2-418-12; C: V20-2-240-5. *Figure by Dorottya Kékegyi and Jill Seagard.*

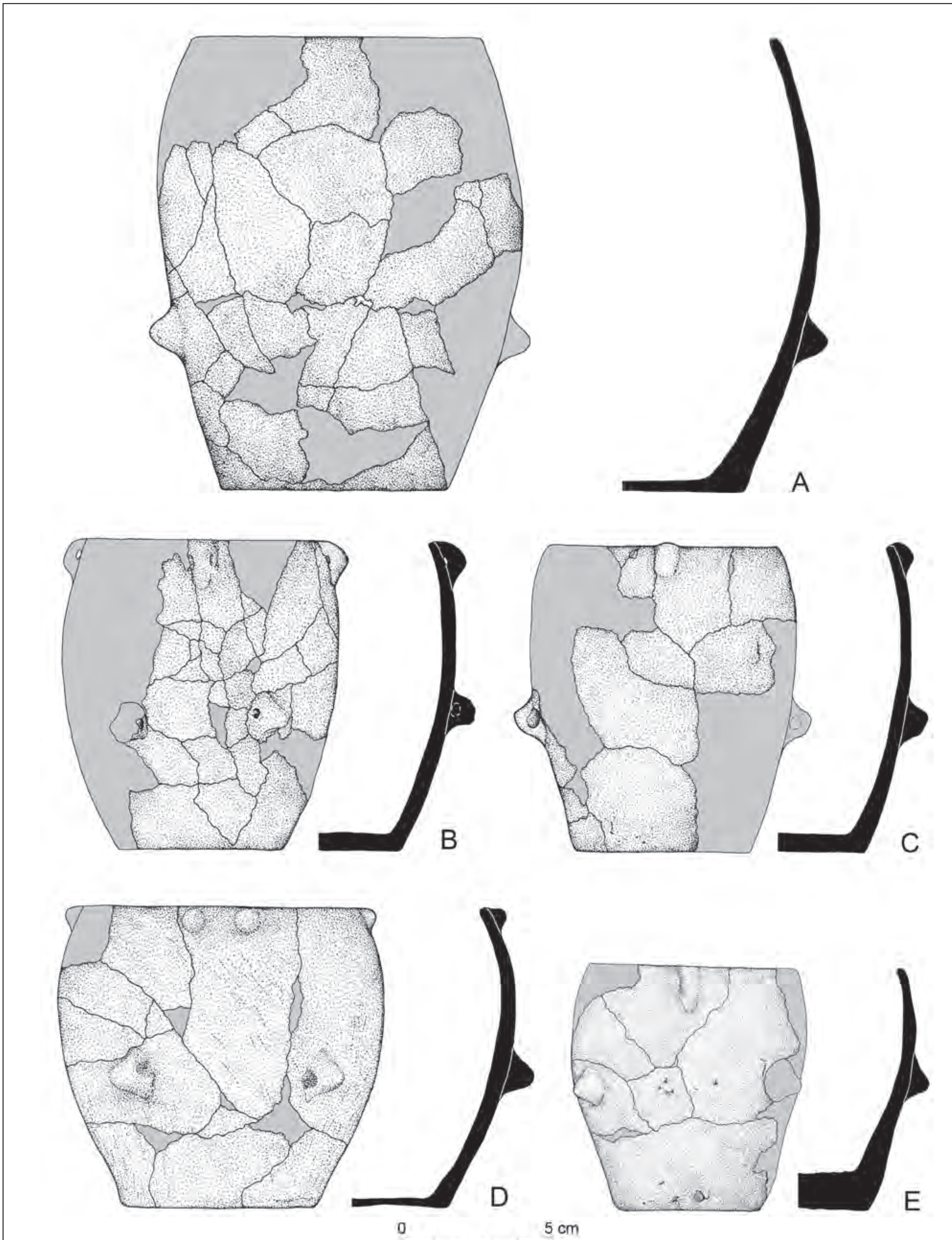


Figure 9.21. Barrel-shaped pots (Type 3.D) from Vésztő-Bikeri (A, C, D) and Körösladány-Bikeri (B, E). A: V20-3-185-51; B: K14-7-046-1; C: V20-3-189-17; D: V20-6-061-1; E: K14-4-103-49. *Figure by Dorottya Kékegyi and Jill Seagard.*

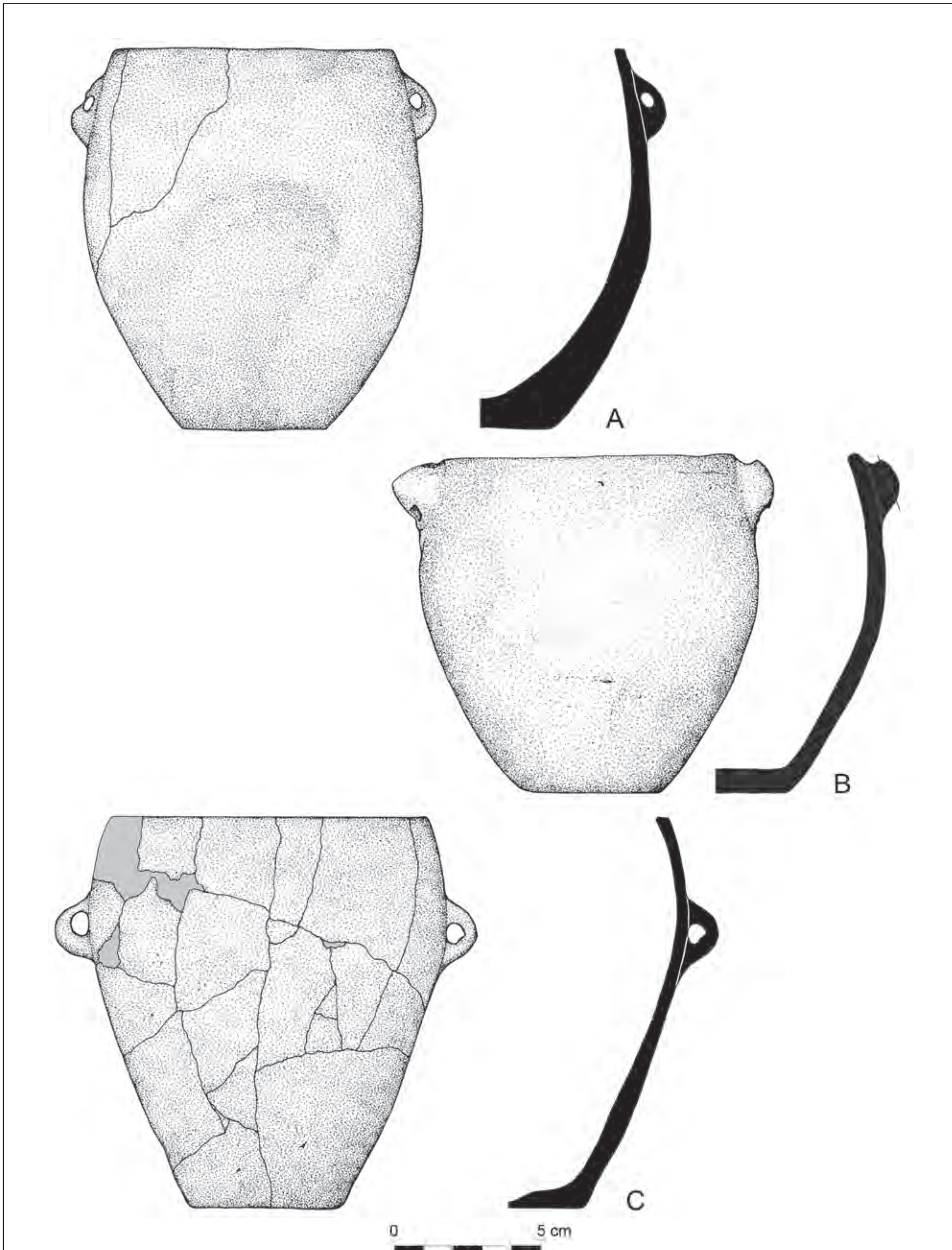


Figure 9.22. Barrel-shaped pots (Type 3.D) from Vésztő-Bikeri (A) and Körösladány-Bikeri (B), and a pot with inverted rim (Type 3.E) from Körösladány-Bikeri (C). A: V20-7-058-20; B: K14-7-064-85; C: K14-4-154-13. *Figure by Dorottya Kékegyi and Jill Seagard.*

4. Jars (Figures 9.23–9.24; Bognár-Kutzián Types D–F)

These vessels have cylindrical or gently concave collars. Jars occur at both Bikeri sites in limited frequencies (Table 9.4), and there are six complete profiles in the assemblages, four from Vésztő-Bikeri and two from Körösladány-Bikeri. The smaller jars might have been serving vessels, and the larger specimens likely were used for storage. Two major variants were distinguished.

4.A. Jars with marked shoulders (Figures 9.23 and 9.24A; Bognár-Kutzián Types D2, E, and F2b–d)

Below the convex, cylindrical, or funnel-like collar, the shoulder markedly widens. The widest part of the vessel is located in the middle section, and the lower profile is convex, conical, or flaring everted. The majority of diagnostic jar fragments belong to the group of fine ceramics, but approximately 5 percent are coarse wares. Based on complete profiles, vessel heights measure 15 to 39 cm. The rim diameter ranges between 8 and 15 cm, but some may exceed 35 cm. These larger, thick-walled specimens were storage vessels more than 70 cm high with large storage capacities (Figures 9.23A, 9.23C, 9.24A). In addition, there are two miniature jars in the Vésztő-Bikeri assemblage (Figure 9.23B).

These jars tend to have one or two sets of lugs attached to the bottom of the collar, the shoulder, or rarely the rim, as well as in the middle section. In several cases, cord wear was recorded in the perforations of the uppermost lugs, suggesting that either lids were tied to the vessels or the vessels were suspended. Incised dots in one to three horizontal rows oftentimes run along the rim or on the shoulder. In addition, interconnected zigzag or diamond-shaped rows of dots and groups of three to nine dots in triangular or diamond-shaped patterns may occur on the collar (Figure 9.33C–D). In rare instances, these patterns continue throughout the body (Figure 9.23C). Large storage jars may have groups of large incised dots (Figure 9.24A). One jar fragment from Körösladány-Bikeri is decorated with a complex system of linear incisions (Figure 9.35K). A few examples of hash-marked incisions on the rim and other plastic applications on the body also were recorded.

4.B. Jars with unmarked shoulders (Figure 9.24B–C; similar to Bognár-Kutzián Types F1a–b and 2a)

The collar of these vessels is closed, and the bulge between the collar and the body is arched. In many cases, the body resembles a barrel-shaped pot. Most fragments are from coarse wares in the Bikeri assemblages, but finer objects also occur in a lower proportion. The two specimens with an entire profile indicate that these vessels were 20–30 cm high, and the rim diameter ranged between 10 and 15 cm. Decorations include four lugs placed on the middle section.

5. Dippers (Figures 9.25 and 9.26A–D; Bognár-Kutzián Type M)

In the two Bikeri assemblages, 75 diagnostic ceramics were identified as dippers, and most of them were recovered at Vésztő-Bikeri (Table 9.4). These convex or conical, finely rubbed or burnished, vessels have straight or gently inverted rims of a diameter of 10–25 cm with a raised tab. The shape of the tab may be triangular (Figure 9.25A), trapezoidal (Figure 9.25B–C), or semicircular (Figures 9.25D and 9.26A–C). Lugs and knobs occasionally are attached to them (Figures 9.25C, 9.26A, 9.26C). In the Körösladány-Bikeri assemblage, there are two rims with boat-shaped attachments on the interior of the tab (Figure 9.26C). A unique rim fragment of a dipper supplied with a pierced and hash-marked "twin rooster" shaped tab was found at Vésztő-Bikeri (Figure 9.26D). A few miniature dippers also were found at both sites.

6. Perforated Vessels (Figure 9.26E; not included in Bognár-Kutzián's typology)

A handful of typically small fragments of densely perforated ceramic vessels was recovered at the Bikeri settlements (Table 9.4). Their bodies have a convex or conical profile. The diameter of the densely placed, round perforations measures 1 to 1.5 mm. Both ends of the vessels may have been open; the narrower one was flat and ring-shaped, and the rim of the wider end was straight. The narrower end of one example is flat and cylindrical inside but squared outside (Figure 9.26E). Rows of incised dots along the interior of the rim at the wider end are visible on another sherd. The function of these vessels is ambiguous. They may have been strainers or sieves. However, the residue analysis of two of the three samples taken from Körösladány-Bikeri specimens showed no traces of animal fat (see Chapter 10, this volume). This artifact type has not been reported from other Tiszapolgár ceramic assemblages.

7. Pedestalled Vessels (Figures 9.27–9.29; Bognár-Kutzián Types H–I)

The frequency of diagnostic sherds from pedestalled vessels is ranked second at Vésztő-Bikeri and third at Körösladány-Bikeri (Table 9.4). The overwhelming majority (98 percent) of these specimens are fine wares. Pedestalled vessels most likely were used for serving food and beverages. Because most of the identified fragments in the Bikeri assemblages represent the bottom or middle sections of pedestals, oftentimes little can be said about the vessel shape.

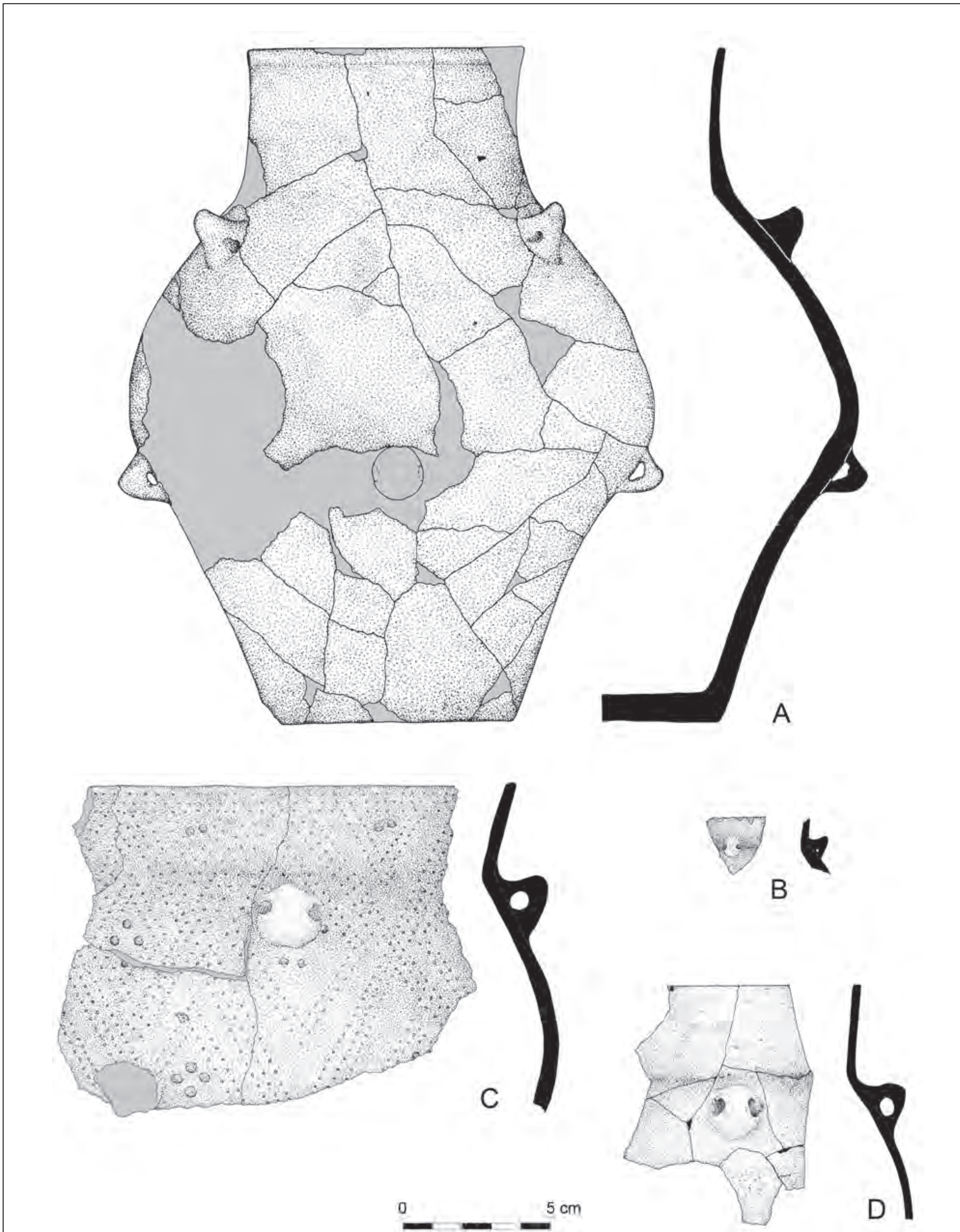


Figure 9.23. Jars with marked shoulders (Type 4.A) from Vésztő-Bikeri (A, B, D) and Körösladány-Bikeri (C). A: V20-3-179-14; B: V20-9-083-4; C: K14-7-055-301; D: V20-3-182-4. *Figure by Dorottya Kékegyi and Jill Seagard.*

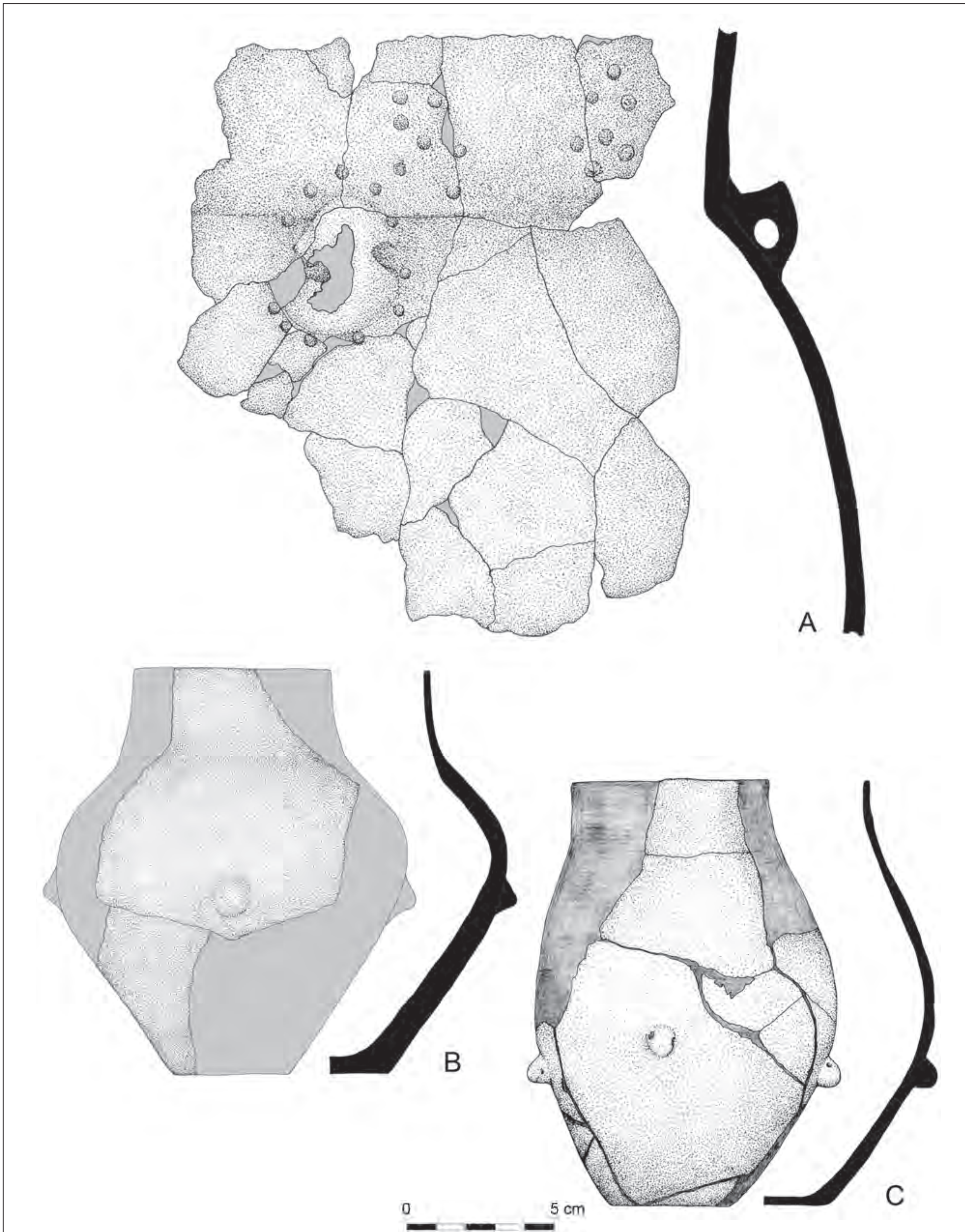


Figure 9.24. Jars with unmarked shoulders (Type 4.B) from Vésztő-Bikeri (A) and Körösladány-Bikeri (B, C). A: V20-2-451-11; B: K14-7-064-108; C: 7-064-97. *Figure by Dorottya Kékegyi and Jill Seagard.*

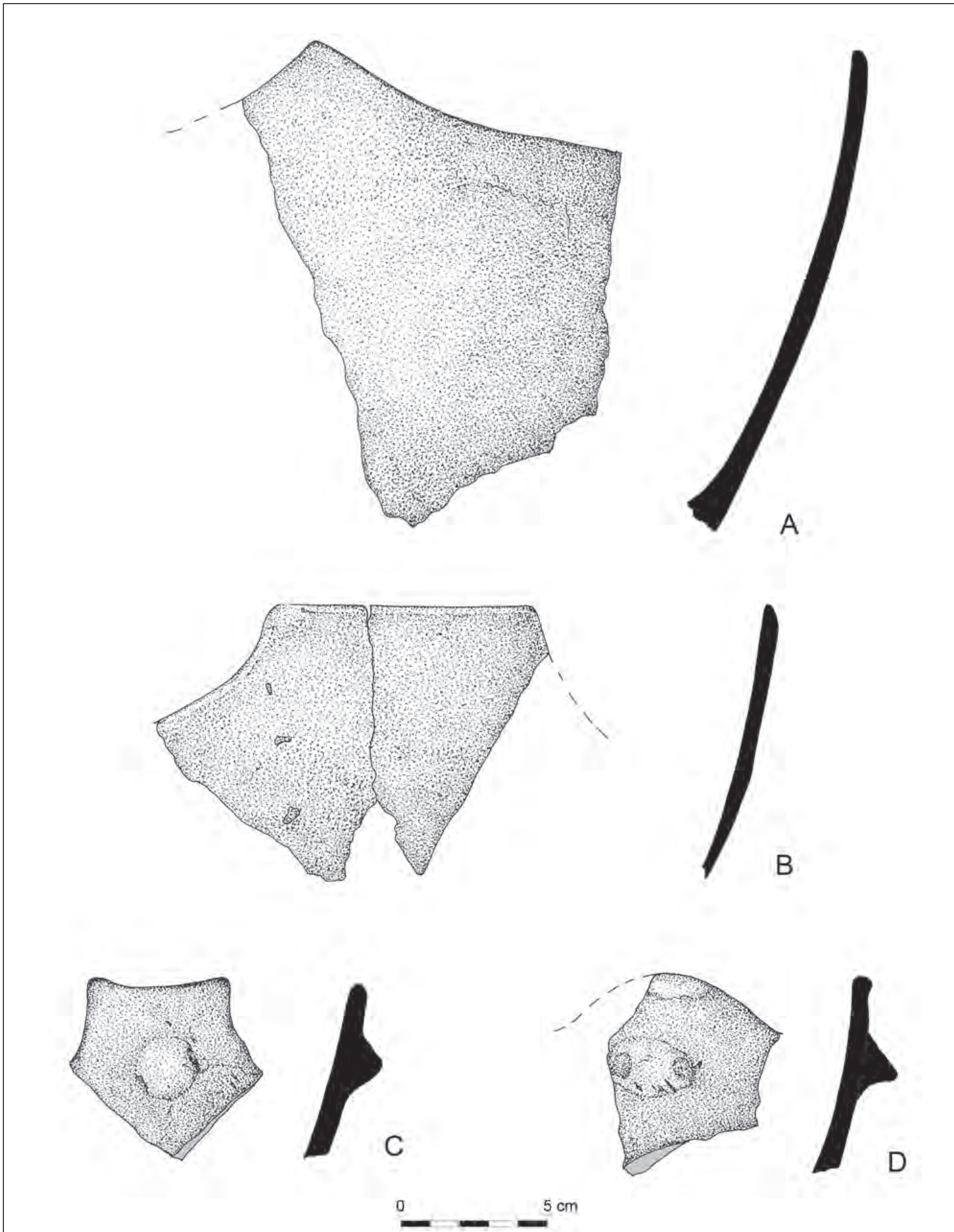


Figure 9.25. Dippers (Type 5) from Vésztő-Bikeri (B–D) and Körösladány-Bikeri (A). A: K14-3-097-1; B: V20-3-176-55; C: V20-3-181-27; D: V20-9-031-12. *Figure by Dorottya Kékegyi and Jill Seagard.*

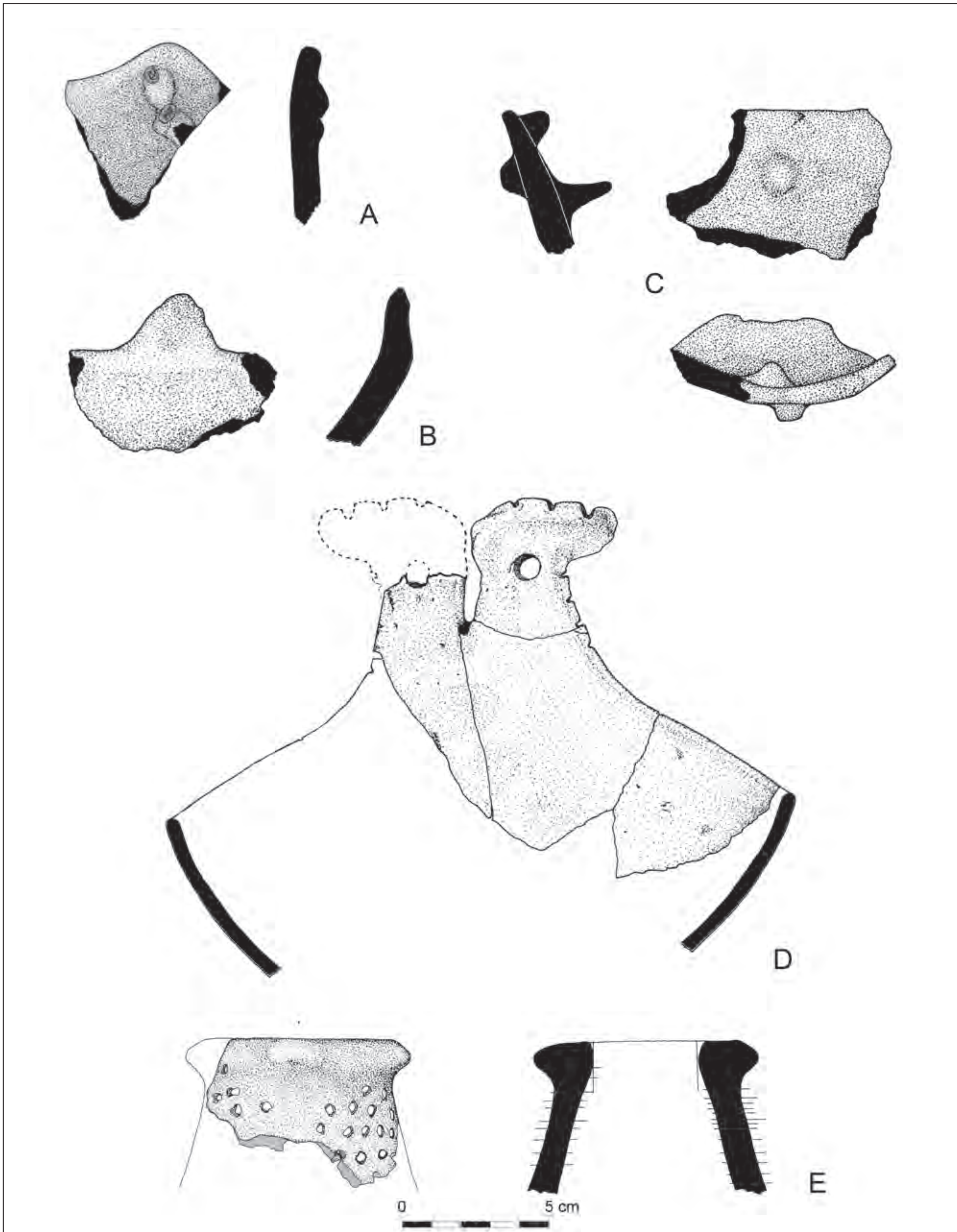


Figure 9.26. Dippers (Type 5) from Vésztő-Bikeri (B, D) and Körösladány-Bikeri (A, C), and a perforated vessel from Körösladány-Bikeri (E). A: K14-7-055-305; B: V20-9-115-108; C: K14-4-084-1; D: V20-9-086-26; E: K14-4-090-2. *Figure by Dorottya Kékegyi and Jill Seagard.*

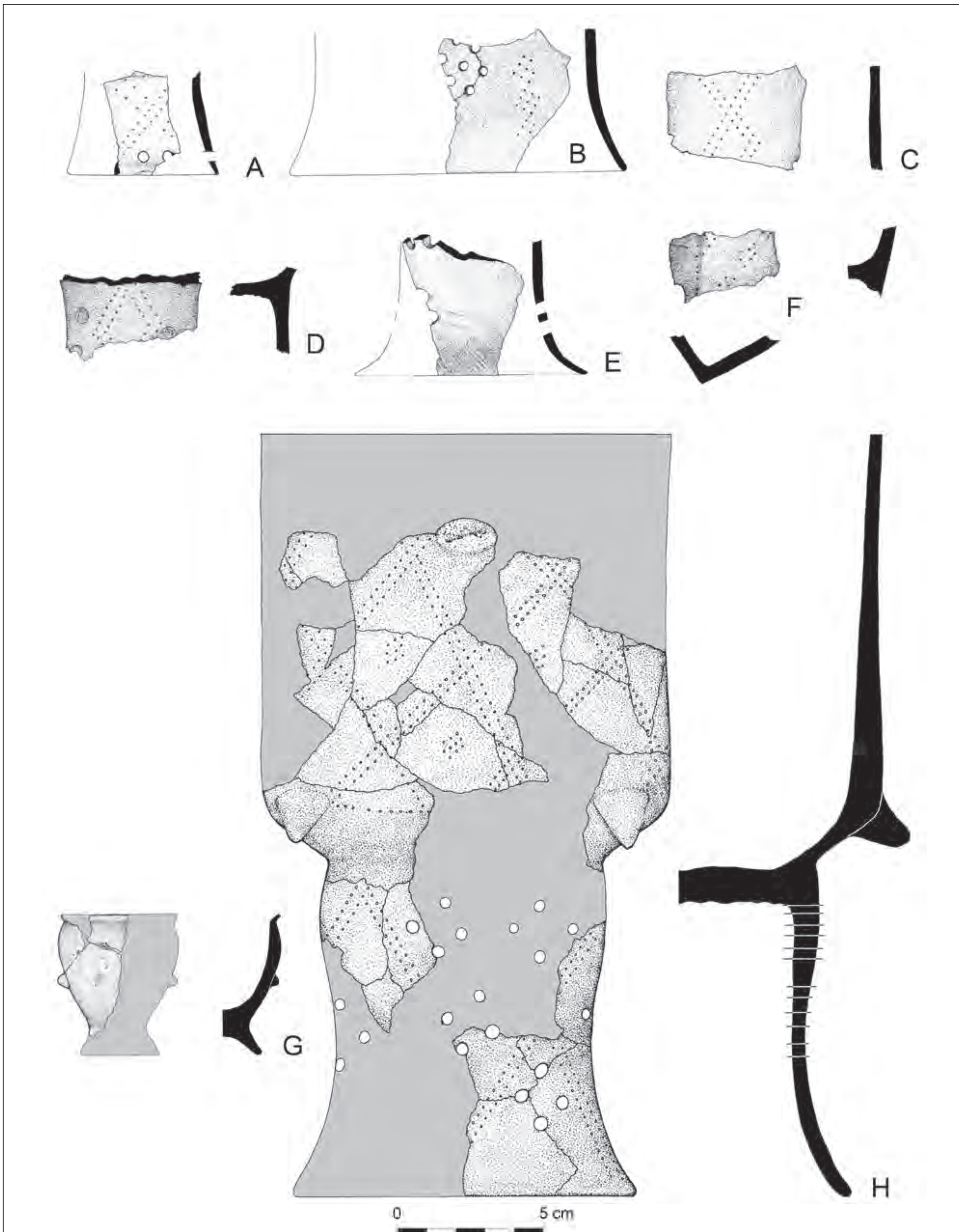


Figure 9.27. Pedestals and pedestalled vessels (Type 7) from Vésztő-Bikeri. A: V20-9-093-28; B: V20-2-143-57; C: V20-2-052-5; D: V20-9-065-5; E: V20-9-064-191; F: V20-3-032-1; G: V20-7-057-45; H: V20-2-143-199. *Figure by Dorottya Kékegyi and Jill Seagard.*

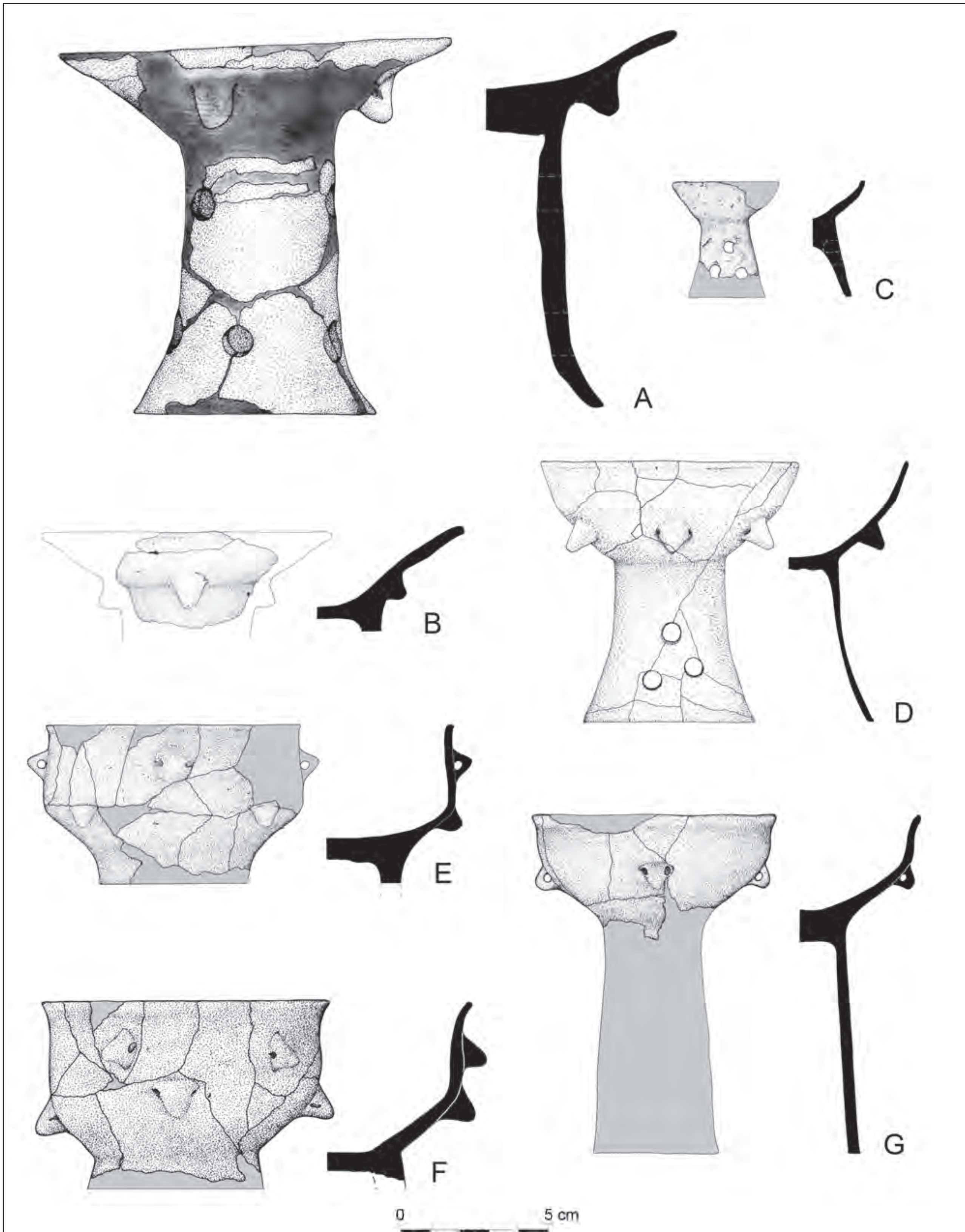


Figure 9.28. Pedestalled bowls (Type 7.A) from Vésztő-Bikeri (C–F) and Körösladány-Bikeri (A, B, G). A: K14-7-055-290; B: K14-3-074-4; C: V20-3-182-47; D: V20-3-152-15; E: V20-3-192-22; F: V20-3-157-17; G: V20-3-212-1. *Figure by Dorottya Kékegyi and Jill Seagard.*

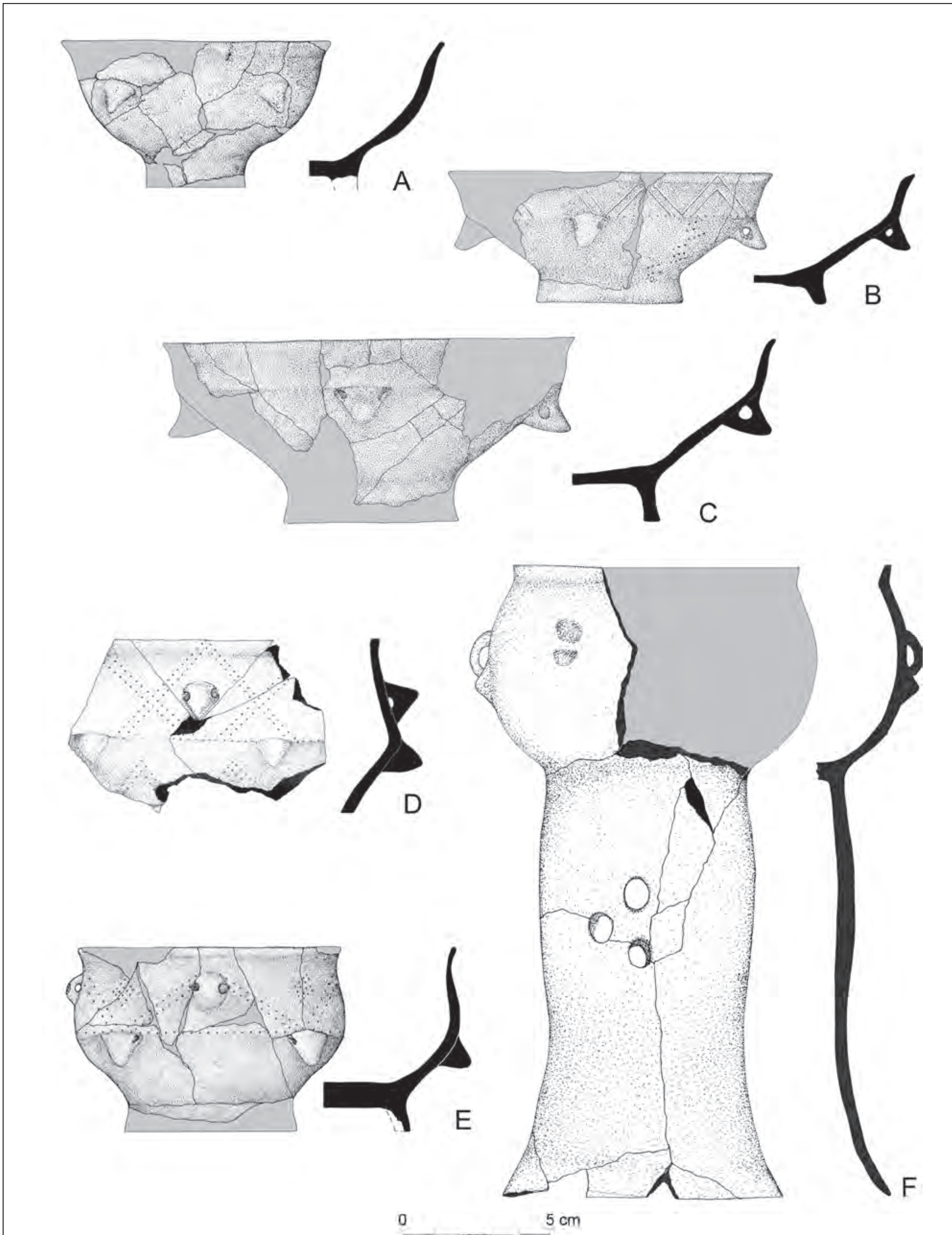


Figure 9.29. Pedestalled bowls (Type 7.A) from Vésztő-Bikeri. A: V20-3-189-49; B: V20-3-212-1; C: V20-3-144-18; D: V20-2-413-59; E: V20-3-178-28; F: V20-3-189-18. *Figure by Dorottya Kékegyi and Jill Seagard*

The pedestal bases are hollow and usually have vertical or slightly concave profiles, but a few bell-shaped specimens also occur (Figure 9.27H). The bottom sections exhibit a flaring shape, and the rim diameters range between 5 and 32 cm, most commonly 10 to 15 cm. Square pedestal bases—which joined the upper vessel in the form of four legs—are represented by 11 items from Vésztő-Bikeri (Figure 9.27F); no square pedestal bases were found at Körösladány-Bikeri. The interior surface of the pedestals is coarse, in some cases with finger marks from manufacturing. The exterior is rubbed or sometimes finely burnished.

Forty-nine percent of the pedestal base fragments from Vésztő-Bikeri and 39 percent from Körösladány-Bikeri have perforations. These round or rarely ovate perforations of various sizes frequently are arranged in sets of most commonly three or four, occasionally up to nine, and they occur in triangular or diamond-shaped designs (e.g., Figures 9.27B, 9.27H, 9.29F). Incised and incrusted dotted patterns include one to three rows of horizontal, vertical, or interconnected diamond-shaped dots and groups of four to 18 (most frequently nine) dots (e.g., Figure 9.27A–D). These motifs are spatially associated with the perforations on the pedestals (Figure 9.27H). On a few sherds, groups of dots in diamond-shaped patterns are vertically arranged on top of each other (Figure 9.27B). In the two assemblages, only three pedestal bases have linear, feathered or cross-hatched, incisions; two are from Vésztő-Bikeri and three are from Körösladány-Bikeri (Figure 9.27E). Bases with incised motifs are significantly more frequent at Vésztő-Bikeri (12 percent) than at Körösladány-Bikeri (2 percent). The few squared pedestals recovered from Vésztő-Bikeri are undecorated, except for a single incised dotted sherd (Figure 9.27F). Apart from lugs at the joint of the pedestal and the vessel in a few cases (Figure 9.28B), plastic ornaments were not applied on pedestal bases.

There are seven fully reconstructed pedestalled vessels in the assemblages, five from Vésztő-Bikeri and two from Körösladány-Bikeri. In four instances, bowls constitute the upper part of these pedestalled vessels at Vésztő-Bikeri, and both pedestalled vessels are bowls from Körösladány-Bikeri (see below). Two additional pedestalled vessels excavated at Vésztő-Bikeri are unknown from other Tiszapolgár sites: a mug 8.5 cm in height with a short pedestal (Figure 9.27G), and a 47 cm high pedestalled pot with tall, vertical walls and a bell-shaped base (Figure 9.27H).

7.A. Pedestalled bowls (Figures 9.28–9.29)

In addition to the fully reconstructed vessels, 30 pedestalled bowls from the Bikeri sites have complete profiles. Based on bowl types attached to the pedestal bases, five subvariants were identified: 7.A.a: Bowls with a convex or conical profile; similar to Type 2.A (Figure 9.28A–D; Bognár-Kutzián Types H1 and H3). A miniature, convex cup on a concave pedestal base with groups of three perforations also was recovered from Vésztő-Bikeri (Figure 9.28C). 7.A.b: Bowls with a convex or conical lower part and cylindrical upper section; similar to Type 2.B.b (Figure 9.28E–F; similar to Bognár-Kutzián Type H41). 7.A.c: Bowls with a conical or convex lower part and everted upper section; similar to Type 2.C (Figures 9.28G and 9.29A–C; not included in Bognár-Kutzián's typology). 7.A.d: Biconical bowls; similar to Type 2.G (Figure 9.29D; Bognár-Kutzián Type I). 7.A.e: Globular bowls; similar to Type 2.H (Figure 9.29E–F; similar to Bognár-Kutzián Type H2). Each subvariant exhibits the same size range and decorative motifs as the comparable bowl type.

8. Lids (Figure 9.30; similar to Bognár-Kutzián Type P)

The characteristic morphological attributes of lids are their conical, flat bodies with straight rims and pedestal-like, hollow, or rarely solid conical or cylindrical handles. The function of some of these artifacts is somewhat ambiguous. The larger variants could have served as small pedestalled bowls. However, wears on the interior of several rims are indicative of their use as lids, most likely for pots or jars.

The abundance of lid sherds in the Körösladány-Bikeri assemblage is considerably higher than that of Vésztő-Bikeri (Table 9.4). The number of examples with a complete profile is four in the Vésztő-Bikeri assemblage and six in the Körösladány-Bikeri assemblage. The overwhelming majority of lids, about 95 percent, are fine wares. Their diameter ranges between 7 and 21 cm, typically 10–15 cm, and their height is between 4 and 7 cm. The diameter of the circular handle measures 3 to 8 cm, commonly 4–5 cm.

The hollow handle type frequently—and the conical body type in several cases—has evenly arranged, round perforations, occasionally in pairs, suggesting that they were fastened to vessels (Figure 9.30B and 9.30D–E). Incised linear decoration is evident on two lid fragments from Vésztő-Bikeri, one of which exhibits a complex pattern of feathered incisions (Figure 9.30E).

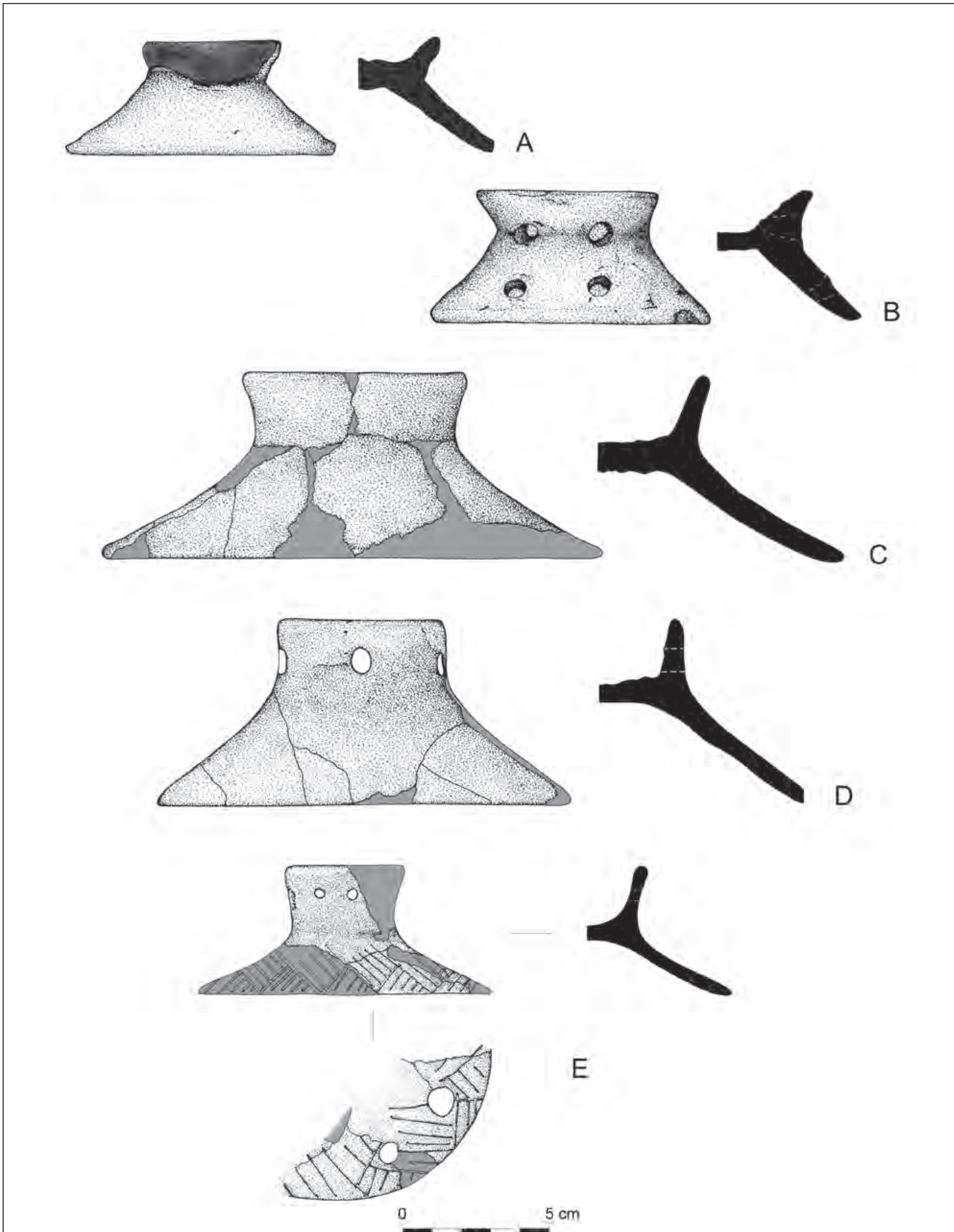


Figure 9.30. Lids (Type 8) from Vésztő-Bikeri (C, E) and Körösladány-Bikeri (A, B, D). A: K14-7-064-88; B: K14-7-064-89; C: V20-3-081-2; D: K14-4-037-5; E: V20-3-212-2. *Figure by Dorottya Kékegyi and Jill Seagard.*

Decorative Elements in the Early Copper Age Ceramic Assemblages of the Bikeri Sites

Decorated ceramics with plastic, incised, perforated, painted, and incrusted motifs—and their various combinations—are present in a remarkably similar proportion in the Bikeri Early Copper Age assemblages: 7.7 percent at Vésztő-Bikeri and 7.3 percent at Körösladány-Bikeri. When the abundance of decorated ceramics within the group of Early Copper Age diagnostics is considered, the Vésztő-Bikeri assemblage shows a somewhat higher frequency (Table 9.5). Because multiple decorative motifs occasionally co-occur on individual vessels, the total number of decorative motifs exceeds the total number of decorated artifacts (see Table 9.6).

1. Plastic Decoration (Figures 9.31–9.32)

Accounting for 24.4 percent of the Early Copper Age diagnostic assemblage at Vésztő-Bikeri and 19.8 percent at Körösladány-Bikeri (Table 9.6), plastic decoration is represented in several forms. These ornaments were attached as appliqués to the ceramics or were created as indentations or channels during the manufacturing process. Some of the plastic appliqués may have had functional roles facilitating the use or transportation of the vessels.

1.A. Lugs (Figures 9.31 and 9.32A–B)

These are the most frequent decorative elements in the Bikeri ceramic assemblages, with 3,547 specimens at Vésztő-Bikeri and 1,005 at Körösladány-Bikeri (Table 9.7). Lugs constitute 97.9 percent of the total number of plastic ornaments at Vésztő-Bikeri and 96.1 percent at Körösladány-Bikeri. When their frequency is considered relative to the total number of decorative motifs in the assemblages, the values also are very similar: 57.7 percent at Vésztő-Bikeri and 58.7 percent at Körösladány-Bikeri. In addition, compared to the total number of recovered Early Copper Age ceramics, including body and diagnostics sherds, lugs occur on 4.9 percent of objects at Vésztő-Bikeri and 4.6 percent at Körösladány-Bikeri.

The number of symmetrically arranged lugs on a vessel is regularly two to four, and they were placed most frequently in the middle section of the body, on the shoulder, at the rim, and occasionally on the neck or directly above the base. On pedestalled vessels, lugs sometimes are located in the joint section of the upper and lower parts (Figure 9.28B). The high frequency of lugs in the Bikeri ceramic assemblages is in part associated with the fact that they tend to co-occur in multiple sections (such as the shoulder and middle sections) of the vessels. Lug size commonly correlates with the size and often the type of the vessel. The height of complete lugs ranges between 0.4 and 4.85 cm.

Table 9.5. Undecorated and decorated diagnostic ceramics in the Vésztő-Bikeri and Körösladány-Bikeri Early Copper Age ceramic assemblages

Diagnostic Ceramics	Vésztő-Bikeri		Körösladány-Bikeri	
	N	%	N	%
Undecorated	9,295	62.7	3,692	69.9
Decorated	5,534	37.3	1,588	30.1
Total	**14,829**	**100**	**5,280**	**100**

Table by William A. Parkinson and Attila Gyucha.

Table 9.6. Major decoration types in the Vésztő-Bikeri and Körösladány-Bikeri Early Copper Age ceramic assemblages

Decoration Type	Vésztő-Bikeri		Körösladány-Bikeri	
	N	%	N	%
Plastic	3,623	24.4	1,046	19.8
Incised	1,363	9.2	248	4.7
Perforated	763	5.1	315	6
Painted	8	0.05	23	0.4
Incrusted	231	1.6	43	0.8

Notes: The numerical value indicates the number of sherds on which the specific decoration type occurs. Multiple decoration types may occur on one object. Percentage value indicates proportion within the group of diagnostic ceramics. *Table by William A. Parkinson and Attila Gyucha.*

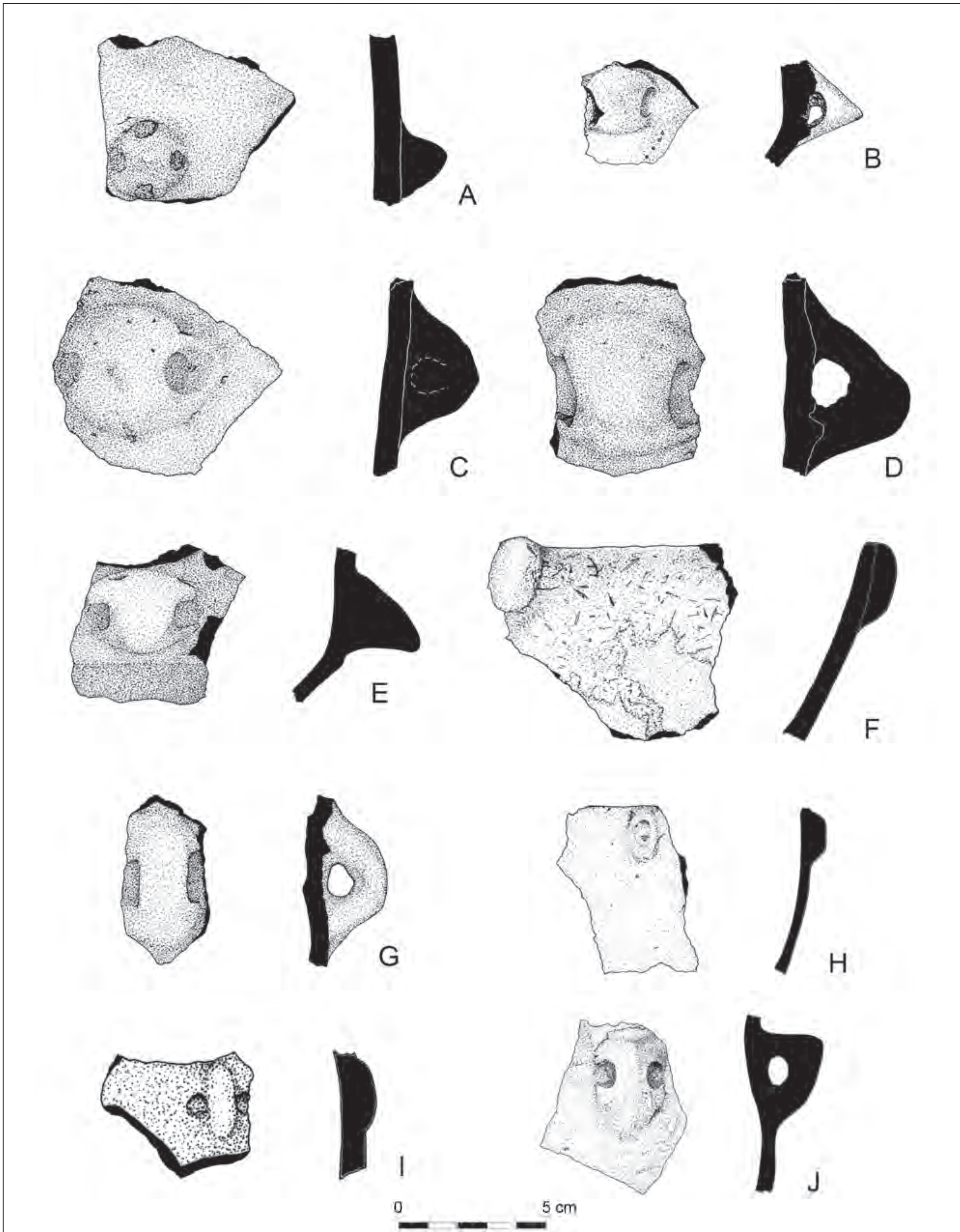


Figure 9.31. Plastic decoration. Major lug types from Vésztő-Bikeri (B, F, H–J) and Körösladány-Bikeri (A, C–E, G). A: K14-3-008-4; B: V20-2-003-2; C: K14-4-103-22; D: K14-4-048-27; E: K14-5-001-5; F: V20-2-301-1; G: K14-5-121-19; H: V20-9-064-193; I: V20-2-433-40; J: V20-7-004-38. *Figure by Dorottya Kékegyi and Jill Seagard.*

The shape of lug base was identified on 3,295 sherds in the Vésztő-Bikeri assemblage and on 889 sherds in the Körösladány-Bikeri assemblage (Table 9.8; Figure 9.31). Six major types can be distinguished: round (38.8 percent of all lugs at Vésztő-Bikeri and 23.8 percent at Körösladány-Bikeri), ovate-horizontal (54.2 percent at Vésztő-Bikeri and 60.4 percent at Körösladány-Bikeri), ovate-vertical (3.2 percent at Vésztő-Bikeri and 14.7 percent at Körösladány-Bikeri), rectangular-horizontal (3.1 percent at Vésztő-Bikeri and 0.9 percent at Körösladány-Bikeri), rectangular-vertical (0.5 percent at Vésztő-Bikeri and 0 percent at Körösladány-Bikeri), and square (0.2 percent at Vésztő-Bikeri and 0.1 percent at Körösladány-Bikeri). Whereas the other types may occur on any vessel types and locations, most ovate-vertical lugs are present at the rims of mugs, bowls, and pots (Figures 9.3A–B, 9.6B–F, 9.21B–C, 9.21E, 9.31F).

The cross-section of lugs was identifiable in 3,059 cases in the Vésztő-Bikeri assemblage and in 843 cases in the Körösladány-Bikeri assemblage (Table 9.9; Figure 9.31). The majority of lugs exhibit semi-pointed cross-sections (53.3 percent at Vésztő-Bikeri and 67.5 percent at Körösladány-Bikeri; Figure 9.31A), followed by round cross-sections at both sites (36.3 percent at Vésztő-Bikeri and 20.5 percent at Körösladány-Bikeri; Figure 9.31C). Additional cross-section forms include pointed (7.9 percent at Vésztő-Bikeri and 5.9 percent at Körösladány-Bikeri; Figure 9.31B), beaked (1.8 percent at Vésztő-Bikeri and 5.5 percent at Körösladány-Bikeri; Figure 9.31E), and rectangular (0.6 percent at both Vésztő-Bikeri and Körösladány-Bikeri; Figure 9.31H). The majority of lugs with these various cross-section forms were applied on multiple vessel types. However, lugs with a beaked cross-section typically are found on jars (Type 4; Figures 9.23A, 9.23C, 9.24A) as well as on fine bowls with a conical or convex lower part and a cylindrical or everted upper section (Types 2.B–C; Figure 9.8F). Lugs with unique cross-sections in the Bikeri assemblages include trapezoid forms with a flat or squared-off tip (Figure 9.32A).

The table of different lug variables demonstrates the overall similarity of the Bikeri assemblages (Table 9.10). However, this table also indicates variation between the two sites that may be related to either the differential abundance of specific vessel types in the assemblages or diachronic changes (see discussion below).

The two assemblages also are very similar from the point of view of lug decoration frequency (Table 9.11). Out of the 3,355 lugs from Vésztő-Bikeri and 938 from Körösladány-Bikeri that are suitable for assessing decoration, undecorated specimens account for 29 percent at Vésztő-Bikeri and 26 percent at Körösladány-Bikeri. A very similar proportion of lugs are pierced (25.2 percent at Vésztő-Bikeri and 26.6 percent at Körösladány-Bikeri; Figure 9.31B, 9.31D, 9.31G, 9.31J), and nearly half of the lugs in the assemblages are semi-pierced (44 percent at Vésztő-Bikeri and 46.6 percent at Körösladány-Bikeri; Figure 9.31C and 9.31E). Pierce diameter ranges from a few millimeters to several centimeters and correlates proportionally with lug size. Use-wear traces suggest that cords sometimes were passed through the pierced lugs, either to suspend the vessels or to secure lids. Two or four round or oval, shallow, horizontal finger or reed impressions are visible on a few semi-pierced lugs (1.8 percent at Vésztő-Bikeri and 0.7 percent at Körösladány-Bikeri; Figure 9.31A).

Lugs tend to be spatially associated with incised patterns, particularly on fine wares. They sometimes are surrounded by groups of two to four incised wide dots (Figures 9.24A, 9.31I, 9.32A) or they break off the continuity of horizontal or diagonal patterns of dotted incisions (Figures 9.27H and 9.29E). The concentric, incrusted, linear incision on the lugs of a bowl at Vésztő-Bikeri is unique in Tiszapolgár assemblages (Figure 9.11A). In addition, a few lugs are vertically finger-impressed or divided by vertical V-shaped cuttings (Figure 9.32A–B).

1.B. Knobs (Figure 9.32C–D)

The small, 0.2–0.9 cm high knobs, semicircular in cross-section, are very rare motifs in the two Bikeri assemblages (Table 9.7). They are arranged a few millimeters apart in a horizontal or diagonal line (Figure 9.32C), occasionally separated by incised, wide dots along or near rims (Figure 9.32D). The identified vessel types with knobs include bowls, pots, and dippers (see Figure 9.26A).

1.C. Handles (Figure 9.32E–F)

A handful of diagnostic artifacts in the assemblages—typically from jars, pots, and bowls—can be classified as handles (Table 9.7). In addition to strap handles, several examples, similar to lugs, were created by perforating a clay-block appliqué (Figure 9.13A). Their cross-section is round or ovate. Commonly, actual handles from large pierced lugs are difficult to distinguish. Some elbow-shaped handles, recovered exclusively from Vésztő-Bikeri, bear a resemblance to Late Neolithic forms (Figure 9.32E).

1.D. Shelves (Figure 9.32G–J)

Shelves are uncommon plastic ornaments in the Bikeri assemblages, occurring on coarse pots and very rarely on bowls and jars (Table 9.7). These appliqués, roughly 1 cm wide and 0.5–1 cm high, typically run parallel to the rim and sometimes are placed in an arched or V-shaped pattern (Figures 9.8A and 9.32G–J). They are hash-marked in most cases.

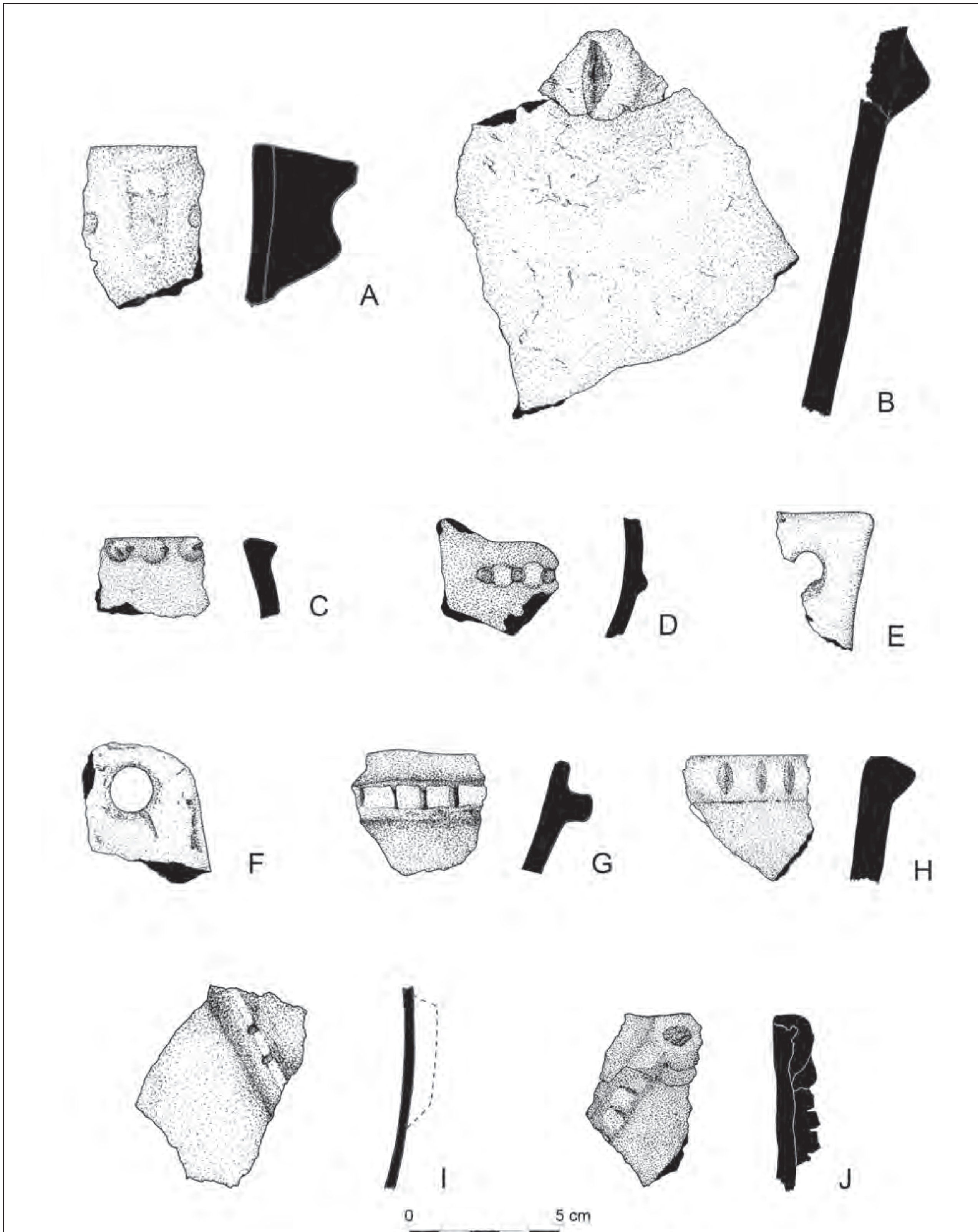


Figure 9.32. Plastic decoration. Lugs from Vésztő-Bikeri (A, B), knobs from Vésztő-Bikeri (C) and Körösladány-Bikeri (D), handles from Vésztő-Bikeri (E, F), and shelves from Vésztő-Bikeri (G–I) and Körösladány-Bikeri (J). A: V20-9-042-26; B: V20-2-325-14; C: V20-7-140-67; D: K14-5-100-8; E: V20-7-052-142; F: V20-3-028-2; G: V20-7-042-3; H: V20-2-118-16; I: V20-2-415-5; J: K14-4-044-2. *Figure by Dorottya Kékegyi and Jill Seagard.*

1.E. Finger indentations

Sequences of finger indentations on rims were recorded on 1 percent of sherds with plastic decorations from Körösladány-Bikeri (Table 9.7), seven of them from pots and one from a flat bowl (Type 2.E; Figure 9.13A). This decoration type is not present in the Vésztő-Bikeri assemblage.

1.F. Channels

Curvilinear, deep channels occur on the upper surface of the basal fragments of rectangular bowls on straight runner legs (Type 2.F; Figure 9.14A–B). These rare motifs were identified exclusively in the Vésztő-Bikeri assemblage (Table 9.7).

2. Incised decoration (Figures 9.33–9.35 and 9.36A–G*)*

Incised motifs occur on 9.2 percent of the Early Copper Age diagnostic ceramics at Vésztő-Bikeri and only 4.7 percent at Körösladány-Bikeri (Table 9.6). As a percentage of the total number of ceramic decoration motifs, incised decorations account for 24.7 percent at Vésztő-Bikeri and 16.7 percent at Körösladány-Bikeri. When the total number of Early Copper Age sherds (body sherds and diagnostics combined) is considered, the proportion of objects with incised decoration is 1.9 percent at Vésztő-Bikeri and lower, 1.1 percent, at Körösladány-Bikeri.

Table 9.7. Decoration types in the Vésztő-Bikeri and Körösladány-Bikeri Early Copper Age ceramic assemblages

Decoration Type			Vésztő-Bikeri		Körösladány-Bikeri	
			N	%	N	%
Plastic Decoration	Lug		3,547	97.9	1,005	96.1
	Knob		4	0.1	5	0.5
	Handle		23	0.6	6	0.6
	Shelf		36	1	18	1.7
	Finger indentation		1	0.03	11	1
	Channel		10	0.3	0	0
	Unique decoration		3	0.1	1	0.1
Incised Decoration	Dotted	Unidentifiable design	471	31	73	25.4
		Linear 1 row	158	10.4	20	7
		Linear 2 rows	452	29.7	39	13.6
		Linear 3+ rows	29	1.9	19	6.6
		Grouped	227	14.9	36	12.5
	Linear	Hash mark	60	3.9	29	10.1
		Short horizontal incision	0	0	2	0.7
		Fingernail	1	0.1	1	0.3
		1 Line	14	0.9	13	4.5
		2 Lines	13	0.9	4	1.4
		3+ Lines	27	1.8	15	5.2
		Spiral	0	0	2	0.7
		Crosshatched	21	1.4	25	8.7
		Feathered	42	2.8	5	1.7
		Concentric diamond	4	0.3	2	0.7
		Meandric	1	0.1	1	0.3
Perforation			763	N/A	315	N/A
Painted Decoration			8	N/A	23	N/A
Incrusted Decoration	With incision		214	92.6	43	100
	Without incision		17	7.4	0	0
Total Occurrences of Decoration Motifs			**6,145**	N/A	**1,713**	N/A

Notes: Decoration types may co-occur, so the totals also include multiple decoration types on one object. Percentage values are relative within major decoration types (such as “plastic decoration”). *Table by Attila Gyucha and William A. Parkinson.*

Table 9.8. Lug base shapes in the Early Copper Age ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri

Base Shape	Vésztő-Bikeri		Körösladány-Bikeri	
	N	%	N	%
Round	1,278	38.8	212	23.8
Ovate-Horizontal	1,785	54.2	537	60.4
Ovate-Vertical	107	3.2	131	14.7
Rectangular-Horizontal	102	3.1	8	0.9
Rectangular-Vertical	15	0.5	0	0
Square	8	0.2	1	0.1
Total	**3,295**	**100**	**889**	**100**

Note: Due to fragmentation, base shape could not be identified for 252 lugs from Vésztő-Bikeri and 116 from Körösladány-Bikeri.
Table by William A. Parkinson and Attila Gyucha.

Table 9.9. Lug cross-section shapes in the Early Copper Age ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri

Cross-Section Shape	Vésztő-Bikeri		Körösladány-Bikeri	
	N	%	N	%
Round	1,111	36.3	173	20.5
Semi-pointed	1,632	53.3	569	67.5
Pointed	242	7.9	50	5.9
Beaked	54	1.8	46	5.5
Rectangular	20	0.6	5	0.6
Total	**3,059**	**100**	**843**	**100**

Note: Due to fragmentation, cross-section could not be identified for 488 lugs from Vésztő-Bikeri and 162 from Körösladány-Bikeri.
Table by William A. Parkinson and Attila Gyucha.

Table 9.10. Lug variables based on base and cross-section shapes in the Early Copper Age ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri

Lug Base Shape/ Cross-Section	Round				Semi-Pointed				Pointed				Rectangular				Beaked			
	V20		K14		V20		K14		V20		K14		V20		K14		V20		K14	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Round	509	17.1	73	9.1	576	19.3	108	13.5	103	3.5	6	0.8	0	0	0	0	16	0.5	4	0.5
Ovate-Horizontal	429	14.4	64	8	986	33	345	43	134	4.5	40	5	0	0	0	0	31	1	35	4.4
Ovate-Vertical	94	3.2	25	3.1	8	0.3	87	10.9	0	0	2	0.3	1	0.03	1	0.1	0	0	5	0.6
Rectangular-Horizontal	54	1.8	3	0.4	14	0.5	1	0.1	2	0.1	1	0.1	2	0.1	1	0.1	4	0.1	0	0
Rectangular-Vertical	6	0.2	0	0	1	0.03	0	0	0	0	0	0	6	0.2	0	0	0	0	0	0
Square	3	0.1	1	0.1	4	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes: V20 = Vésztő-Bikeri, K14 = Körösladány-Bikeri. Due to fragmentation, types could not be identified for 564 lugs from Vésztő-Bikeri and 203 from Körösladány-Bikeri. *Table by William A. Parkinson and Attila Gyucha.*

Table 9.11. Lug decoration techniques in the Early Copper Age ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri

Decoration	Vésztő-Bikeri		Körösladány-Bikeri	
	N	%	N	%
Plain	973	29	244	26
Pierced	845	25.2	250	26.6
Semi-Pierced	1,478	44	437	46.6
Multiple Semi-Pierced	59	1.8	7	0.7
Total	**3,355**	**100**	**938**	**100**

Note: Due to fragmentation, decoration techniques could not be identified for 192 lugs from Vésztő-Bikeri and 67 from Körösladány-Bikeri.
Table by William A. Parkinson and Attila Gyucha.

Two major variants of incision—dotted and linear—are present in the assemblages. To produce small dots and lines, bone or wooden tools were utilized on leather-hard ceramics. Larger incised dots likely were created by plant stems, reeds, or hollow wooden dowels. Many incised sherds are small and/or weathered; as a result, spatial patterns frequently could not be distinguished. There are eight whole vessels with complete patterns of incised motifs in the Vésztő-Bikeri assemblage and two in the Körösladány-Bikeri assemblage.

2.A. Dotted incisions (Figures 9.33–9.34)

These motifs amount to 88 percent of the incised decorations at Vésztő-Bikeri and significantly less, 65.2 percent, at Körösladány-Bikeri (Table 9.7). The difference in abundance is even more striking when the frequency of dotted incisions is compared to the total number of decoration motifs at the sites, with 21.8 percent at Vésztő-Bikeri and 10.9 percent at Körösladány-Bikeri. In the Vésztő-Bikeri assemblage, 82 percent of the dotted incised sherds exhibit dots measuring 0.5 to 3 mm in diameter, 8 percent range between 3 and 5 mm, and 10 percent have dots larger than 5 mm in diameter. At Körösladány-Bikeri, these values are 54, 26, and 20 percent, respectively. Incised dots were applied most frequently on the cylindrical or everted upper parts of bowls (Types 2.B and 2.C), including pedestalled bowls (Types 6.A.c and 6.A.d; Figures 9.8D, 9.10H, 9.29D–E, 9.33A–B, 9.34C, 9.34H). They also occur along the rim or on the entire surface of pedestal bases (Figure 9.27A–D, 9.27F, 9.27H), on jars, and occasionally on the body of tumblers and pots (Figures 9.6A, 9.19A, 9.23C, 9.24A). In terms of design, they are arranged in either linear patterns or groups, and these patterns oftentimes are combined (Figures 9.23C, 9.27H, 9.29E, 9.33C–E). The complete or larger portion of the design is identifiable on 62.9 percent of dotted incised ceramics at Vésztő-Bikeri and 61 percent at Körösladány-Bikeri.

2.A.1. Dotted incisions in linear patterns

This motif was recorded on 73.8 percent of the dotted incised sherds with an identifiable design from Vésztő-Bikeri and 68.4 percent from Körösladány-Bikeri (Table 9.7). A low proportion of dotted ceramics is decorated with a single horizontal row of dots in both the Vésztő-Bikeri and Körösladány-Bikeri assemblages; this motif usually is located along the rim or the pronounced shoulder break of the vessel and commonly is combined with other motifs (Figures 9.9C, 9.29D–E and 9.33A). Dotted incisions of two closely spaced rows running horizontally along rims also occur at both sites (Figure 9.34A and 9.34C). These rows occasionally are perpendicular. Zigzag designs of two parallel rows of dots are frequently present in the upper section of the vessels (Figures 9.10H and 9.33C). On bowls, the combination of a single horizontal row of dots along the shoulder line and a zigzag pattern of two rows of dots on the neck is common (Figures 9.9C and 9.33B). In these cases, the rows are often associated spatially with lugs (Figure 9.29E). Interweaving zigzags many times form diamond-shaped patterns (e.g., Figures 9.29D and 9.33A), and similar vertically aligned motifs are seen on pedestals (Figure 9.27A and 9.27C–D). These interconnected diamond-shaped patterns occasionally cover entire vessel exteriors (Figures 9.23C and 9.27H). Groups of dots or lugs tend to appear in the voids of zigzag and diamond-shaped patterns (Figures 9.23C, 9.27H, 9.29D–E, 9.33C–E). In addition, rows of three dots occur rarely at Vésztő-Bikeri (1.9 percent of the total number of incised motifs) but more frequently at Körösladány-Bikeri (6.6 percent).

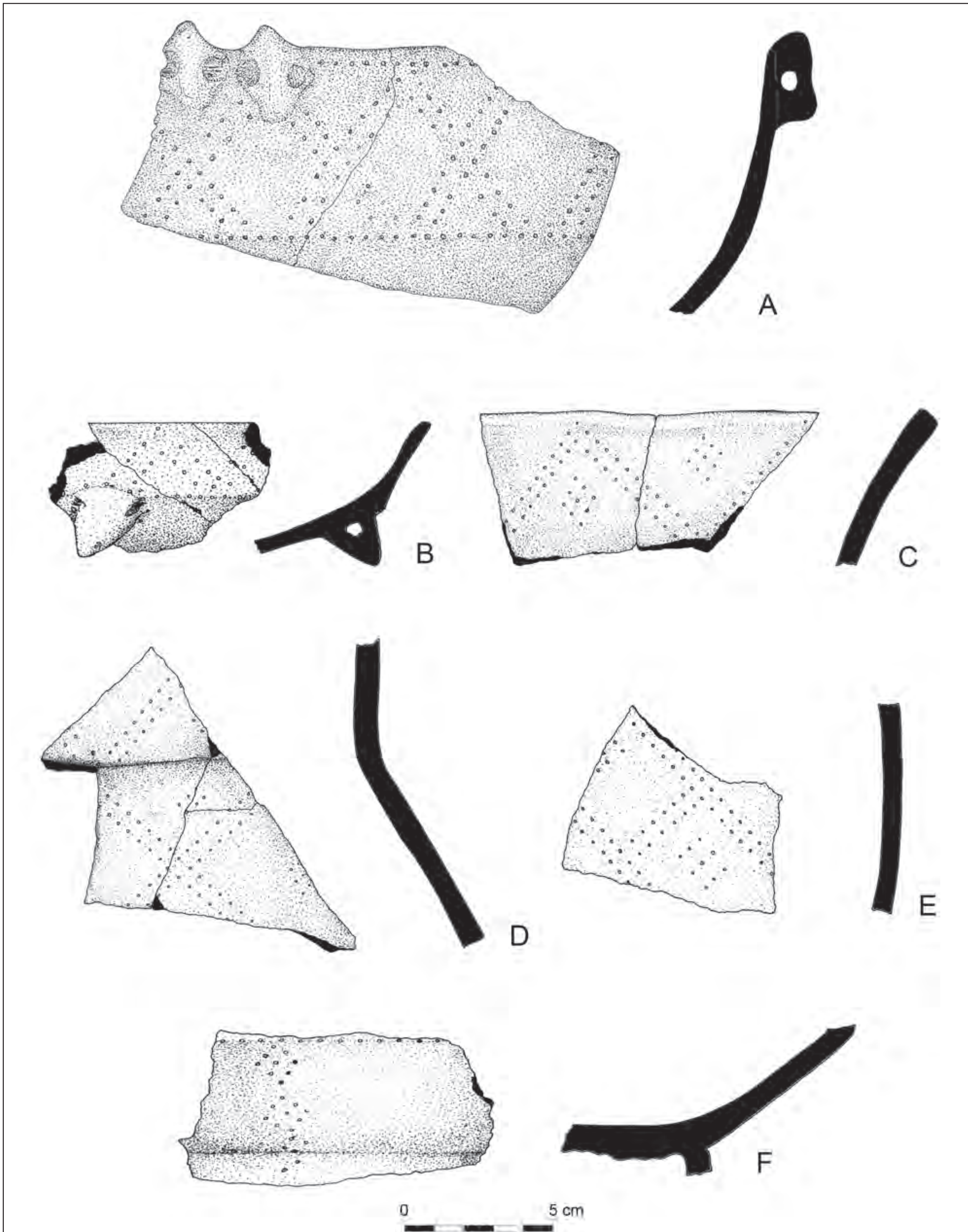


Figure 9.33. Incised decoration. Dotted incisions from Vésztő-Bikeri. A: V20-3-188-32; B: V20-2-276-2; C: V20-2-200-44; D: V20-2-200-46; E: V20-2-437-14; F: V20-7-007-63. *Figure by Dorottya Kékegyi and Jill Seagard.*

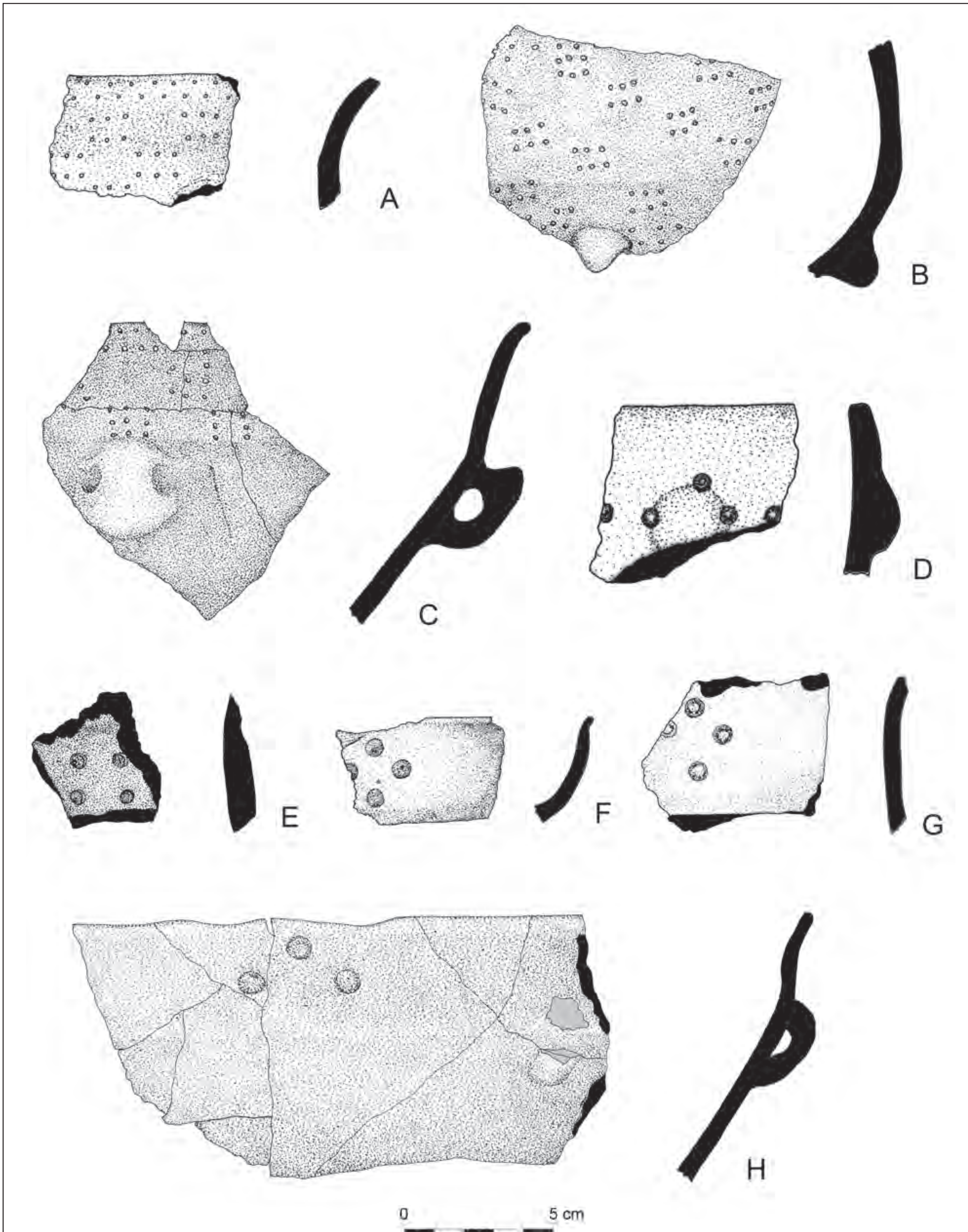


Figure 9.34. Incised decoration. Dotted incisions from Vésztő-Bikeri (A–D, F–H) and Körösladány-Bikeri (E). A: V20-3-255-19; B: V20-4-001-182; C: V20-3-010-40; D: V20-9-054-57; E: K14-5-047-8; F: V20-8-013-19; G: V20-7-007-36; H: V20-3-174-63. *Figure by Dorottya Kékegyi and Jill Seagard.*

2.A.2. Dotted incisions in groups

The abundance of grouped dotted incisions is similar in the Bikeri assemblages, accounting for 14.9 percent of the total number of incised motifs at Vésztő-Bikeri and 12.5 percent at Körösladány-Bikeri (Table 9.7). Complete designs are visible on 84 sherds from Vésztő-Bikeri and 13 sherds from Körösladány-Bikeri; the rest are too fragmentary to distinguish patterns. At Vésztő-Bikeri, 75 of these sherds exhibit small incisions (less than 5 mm in diameter) grouped in a diamond-shaped pattern, seven have dots aligned in a triangle pattern, and two display an oblong design. In the Körösladány-Bikeri ceramic assemblage, the diamond-shaped and triangle patterns occur on five sherds, and the oblong design occurs on three artifacts. Diamond-shaped groups are comprised of four to 18 dots. The most common number of dots is nine, making up 63 percent of the completely visible group motifs in the Vésztő-Bikeri assemblage (e.g., Figures 9.6A, 9.27H, 9.29E, 9.33C). Triangular patterns are composed of three dots in each case (Figures 9.19A and 9.34H), while oblong designs usually contain six dots (Figure 9.34A–B), with a few cases exhibiting nine or 12 dots (Figure 9.34C). Grouped dotted motifs commonly occur in association with dotted linear ornaments (Figures 9.23C, 9.27H, 9.29E, 9.33C–E) and lugs (Figures 9.24A and 9.34D), in a vertical alignment on top of each other (Figures 9.27B and 9.33F), and in a chessboard pattern (Figure 9.34A–C). Apart from triangular patterns, large dots created using reed or hollow wooden dowels were organized into sets of four dots arranged in a rectangular or diamond-shaped design (Figures 9.8D, 9.23C, 9.34E–G).

In addition to tools, fingers also were used to decorate ceramics. Lentil-shaped, shallow finger impressions of 7 to 15 mm in diameter occur in patterns similar to those of the large incised dots. They were applied on the neck, shoulder, and body of fine and coarse bowls and jars (Figure 9.19A). In a few cases, this technique was applied on the interior of bowls with flaring profiles (Type 2.D).

2.B. Linear incisions (Figures 9.35 and 9.36A–G)

These motifs are nearly three times more abundant among the incised motifs at Körösladány-Bikeri (34.9 percent) than at Vésztő-Bikeri (12 percent; Table 9.7). Considering the total number of all types of decorations, the difference is nearly twofold: 5.8 percent at Körösladány-Bikeri and 3 percent at Vésztő-Bikeri. Linear incisions are present on mugs (e.g., Figure 9.35C), bowls (e.g., Figure 9.11), pedestalled vessels (e.g., Figure 9.27E), pots, jars (e.g., Figure 9.35K), and a lid (Figure 9.30E). Regarding location, linear incisions are found most commonly in the upper sections of vessels. Complex patterns may cover both the exterior and interior of bowls (Figures 9.11, 9.35E, 9.36C–E). Compared to dotted incisions, a broader variety of linear motifs occurs in less standardized combinations.

2.B.1. Simple linear incised patterns

This group includes recurrent short lines (hash marks, sets of short incisions, and fingernail impressions), single or groups of continuous lines, and spiral motifs. More than 60 percent of linear incised patterns are composed of these incisions in both assemblages (Table 9.7). Because, similar to those with dotted incisions, sherds with linear incisions frequently are very fragmented, the motifs also may have been part of more complex decorations.

At Vésztő-Bikeri, 27 rims of primarily coarse mugs, bowls, jars, and pots had sequences of short vertically or diagonally placed hash marks located 0.2 to 1 cm apart. There were 18 at Körösladány-Bikeri (Figure 9.18B). The majority of shelves (Figure 9.32G–J), as well as the unique “twin rooster”–shaped tab from Vésztő-Bikeri, also were decorated in this fashion (Figure 9.26D). Similar motifs are present on rectangular bowls with straight runner legs (Type 2.F) in the Vésztő-Bikeri assemblage (Figure 9.14A). Sets of short, vertically oriented, linear incisions occur on two ceramics from Körösladány-Bikeri, and these lines are arranged in a rectangular panel on another sherd from the same site. One fingernail-impressed Early Copper Age fragment was identified from each site.

A single incised line was identified on 14 sherds from Vésztő-Bikeri and 13 from Körösladány-Bikeri. Double rows of incised lines occur on 13 objects from Vésztő-Bikeri and four from Körösladány-Bikeri (Table 9.7). Three or more rows of incised lines are more common. There are 27 sherds with up to seven lines placed along the rim or on the shoulder of vessels from Vésztő-Bikeri, and 15 ceramics from Körösladány-Bikeri exhibit the same pattern. Linear incisions also appear in V-shaped, upside-down V-shaped, curvilinear, and zigzag patterns (Figures 9.29B and 9.35A–B). Horizontal lines occasionally enclose complex dotted and/or linear incised motifs (Figure 9.35C). In addition, spiral incisions occur on one tiny sherd from each site.

2.B.2. Complex linear incised patterns

These patterns include crosshatched, feathered, concentric diamond, and meandric designs at the Bikeri sites. Their frequency, relative to the total number of linear incisions, is more than two times higher at Körösladány-Bikeri than at Vésztő-Bikeri, with 11.4 percent and 4.6 percent, respectively (Table 9.7). There is a slight difference when

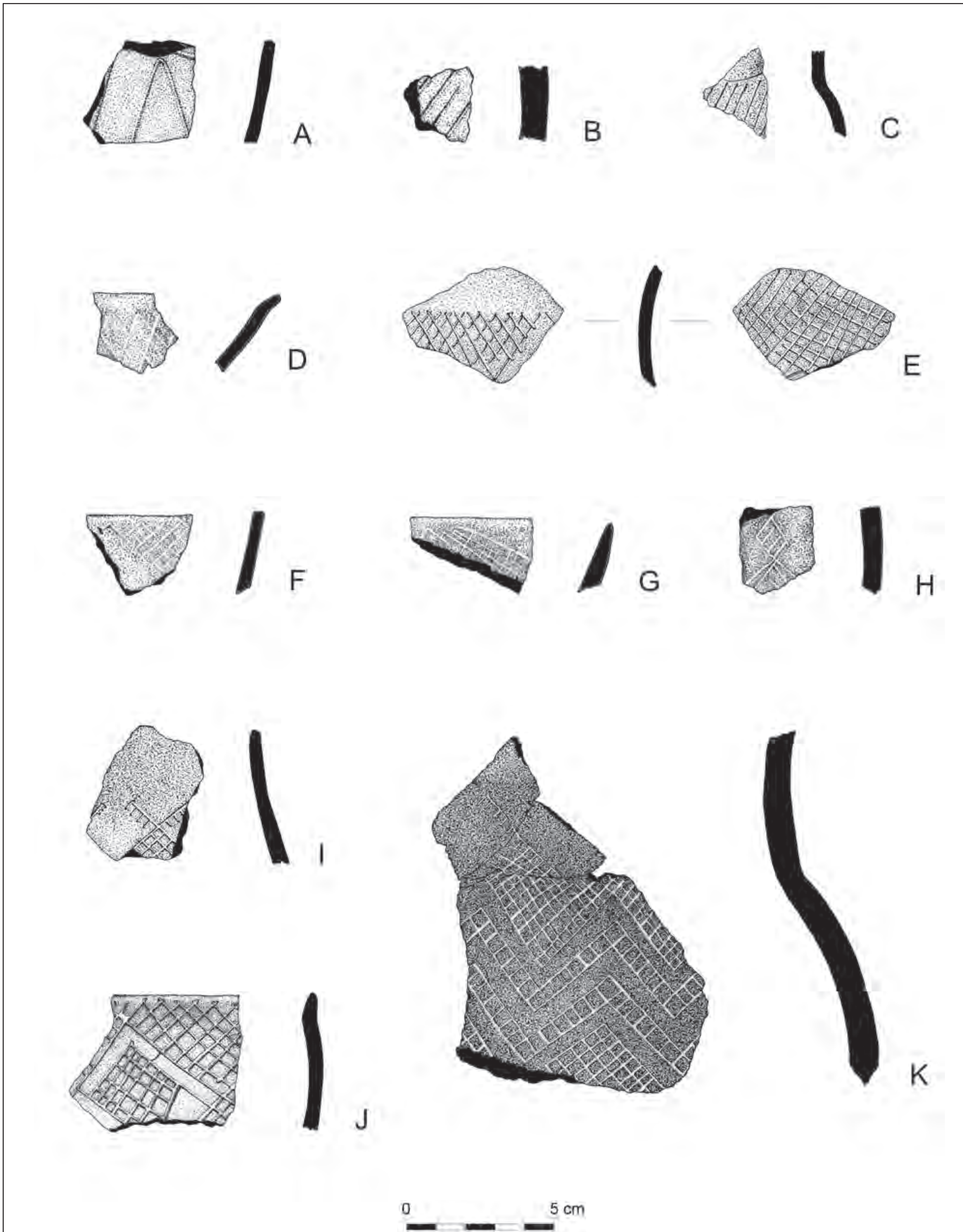


Figure 9.35. Incised decoration. Linear incisions from Vésztő-Bikeri (A–D, F–H) and Körösladány-Bikeri (E, I–K). A: V20-4-084-3; B: V20-2-381-7; C: V20-3-010-20; D: V20-2-198-55; E: K14-5-100-9; F: V20-3-251-2; G: V20-2-244-2; H: V20-2-445-54; I: K14-4-033-8; J: K14-4-033-9; K: K14-4-109-5. *Figure by Dorottya Kékegyi and Jill Seagard.*

their abundance is considered in relation to the total number of all types of decorative motifs, with 1.9 percent at Körösladány-Bikeri and 1.1 percent at Vésztő-Bikeri. The frequency of individual complex linear incised designs varies significantly: feathered incisions are much more common at Vésztő-Bikeri, and other motifs—crosshatched in particular—occur in a higher proportion at Körösladány-Bikeri. Furthermore, the designs are more convoluted in the Körösladány-Bikeri assemblage than at Vésztő-Bikeri (see discussion below). These complex patterns commonly are organized into panels or bands on the vessels. The combination of motifs in conjugated, linked, and interconnected zones is frequent.

Crosshatching was applied in bands along the rim and on the shoulder of bowls, on both the exterior and interior (Figures 9.11B and 9.35E), and also occurs in interconnected panels of incised triangles (Figure 9.35E–F and 9.35I). V-shaped or upside-down V-shaped crosshatched zones also are present on small, highly fragmented sherds, possibly representing interconnected triangle patterns (Figure 9.35G–H). Crosshatches are commonly associated spatially with dotted and other forms of linear incised patterns. V-shaped, comb-like, and feathered linear motifs diverge from triangular, crosshatched panels on several sherds (Figure 9.35H). A few ceramics from Körösladány-Bikeri were decorated with complex patterns of zigzag bands, triangles, and rectangular patterns filled with crosshatches and alternating with void bands and zones (Figure 9.35J–K).

Feathered linear incised patterns also occur on both the exterior and interior of vessels. Most commonly bowls (Figures 9.11B and 9.36D), several pedestal bases (Figures 9.27E and 9.36A), and a lid (Figure 9.30E) exhibit this design. The co-occurrence of feathered and crosshatched motifs is common; the best example is a bowl from Vésztő-Bikeri (Figure 9.11B). This vessel has feathered incisions in the form of interconnected incised triangles on the interior, while on the exterior, the neck is decorated with a crosshatched band. Furthermore, three vertical lines with diagonally placed short incisions stretch from the lugs on the shoulder to the base. Feathered incisions on the interior also co-occur with dotted incised motifs on the exterior on several bowl sherds. These are more common at Vésztő-Bikeri (Figure 9.36C–D).

Concentric, interconnected, diamond-shaped incisions (Figure 9.36E–G) and diamond-shaped incisions filled with diagonal incised lines (Figure 9.35H) also are found in the Bikeri assemblages. The everted upper section of an impressive bowl from Vésztő-Bikeri is ornamented with interconnected, concentric, diamond-shaped motifs (Figure 9.11A). Meandering incised linear designs occur on a single sherd from Körösladány-Bikeri (Figure 9.36E).

3. Perforations

Perforations occur on 5 to 6 percent of the diagnostic sherds in both assemblages (Tables 9.6–9.7). They appear primarily on pedestal bases. At Vésztő-Bikeri 98.7 percent and at Körösladány-Bikeri 95.2 percent of the perforations are on pedestals. The rest are on lids. Relative to the total number of all decoration motifs, individual or groups of perforations occur in 12.4 percent at Vésztő-Bikeri and 18.4 percent at Körösladány-Bikeri. This variation might be associated with the higher percentage of pedestalled vessels and lids at Körösladány-Bikeri (see Table 9.4). While perforations served primarily practical purposes on lids (for fastening them to vessels with strings), it remains unclear whether the perforations on pedestal bases were necessitated by manufacturing techniques or utilization, or whether they reflect stylistic preferences. Nevertheless, the regular spatial patterning indicates that aesthetics played a role in their application.

The round perforations on pedestal bases vary between 0.3 and 3.7 cm in diameter. Several sherds from Vésztő-Bikeri have large, ovate-vertical piercings. Concerning patterning, groups of three perforations occur in a triangle arrangement (Figures 9.28C–D and 9.29F), while groups of four or more perforations usually were organized into a diamond-shaped design (Figure 9.27B and 9.27H). The majority of pedestal bases with perforations from both sites are too fragmented to identify spatial patterns. Four evenly distributed small perforations of 0.4 to 1 cm in diameter were placed on 10 lid handles and lid rim fragments in the Vésztő-Bikeri assemblage and on 15 in the Körösladány-Bikeri assemblage (Figure 9.30B and 9.30D–E).

4. Painted Decoration (Figure 9.36H–I)

There are a total of eight painted sherds (0.1 percent of the total number of decoration motifs) in the Vésztő-Bikeri assemblage and 23 (1.3 percent) in the Körösladány-Bikeri assemblage (Tables 9.6 and 9.7). From Vésztő-Bikeri, six sherds may have been covered with white paint; however, it is plausible that these artifacts belonged to vessels covered with a thin clay slip, the color of which changed to white when the pots were being fired. In addition, a single body sherd exhibits a vertical, narrow, painted black stripe, and a small rim has a wide black band on the exterior at Vésztő-Bikeri.

In the Körösladány-Bikeri assemblage, 22 painted sherds from a minimum of four, thin-walled bowls were found in Feature 49, a large circular pit in Block 7. Another painted sherd was recovered from Feature 28, a bell-shaped pit in Block 4 (see Chapter 7, this volume). The exterior of all 23 sherds, and in some instances also the interior, was

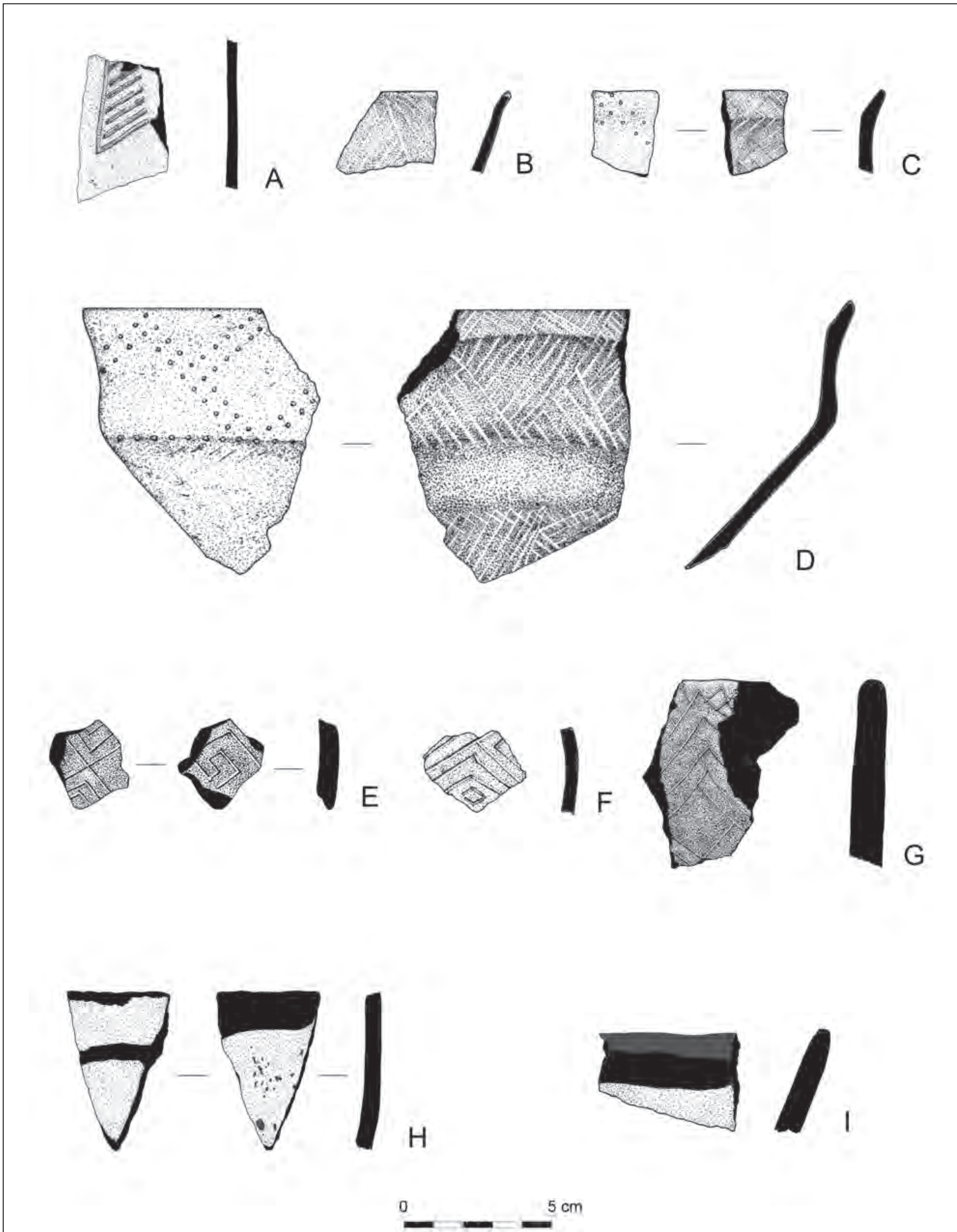


Figure 9.36. Linear incisions from Vésztő-Bikeri (A–D, F) and Körösladány-Bikeri (E, G), and painted decoration from Körösladány-Bikeri (H, I). A: V20-2-372-1; B: V20-2-421-4; C: V20-2-205-13; D: V20-2-386-1; E: K14-4-124-49; F: V20-2-413-56; G: K14-6-015-1; H: K14-4-133-1; I: K14-7-056-180. *Figure by Dorottya Kékegyi and Jill Seagard.*

covered with monochrome, thick (pastose) red paint applied after firing. A rim sherd from Feature 28 has wide black bands on both the interior and exterior (Figure 9.36H). A similar black band occurs below a red band on one of the sherds from Feature 49 (Figure 9.36I).

5. Incrusted Decoration

Elemental studies indicate that burned, crushed animal—perhaps even human—bones were utilized as incrustation material at the Bikeri sites (Parkinson et al. 2010b). This decoration type was recorded on 1.6 percent of the diagnostic ceramics at Vésztő-Bikeri and 0.8 percent at Körösladány-Bikeri (Table 9.6). More commonly, the white paste was pressed into dotted and linear incisions, the traces of which are still sometimes visible. In the Vésztő-Bikeri ceramic assemblage, 92.6 percent of the incrusted decorations are preserved inside dotted and linear incisions. This value is 100 percent at Körösladány-Bikeri (Table 9.7).

Preserved white paste without incisions is visible on 10 collared mug (Type 1.D) sherds and seven additional ceramics found in the eastern part of the Feature 4/14 building at Vésztő-Bikeri (Table 9.7; see Chapter 7, this volume). On the collared mugs, this decorative element occurs around lug bases and from the rim to the belly in interconnected diamond-shaped patterns.

The Broader Context of Ceramic Technology, Types, and Decoration at the Bikeri Sites

The ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri represent characteristic Early Copper Age Tiszapolgár pottery techniques, vessel forms, and decorative elements, most of which are well-known from contemporaneous sites across the Great Hungarian Plain and beyond. Based on morphological variables, eight major vessel types (mugs, bowls, pots, jars, dippers, pedestalled vessels, lids, and perforated vessels) and their variants, as well as many subvariants, were distinguished in the Bikeri assemblages. The overall vessel shapes seem to be highly standardized. However, variants that share the physical attributes of different vessel types also are present, making the development of a clear-cut typological classification fairly complicated (see also Parkinson 2006a:164).

The predecessors of many vessel types from the Bikeri villages occur in the ceramic assemblages of various Late Neolithic cultural units on the Great Hungarian Plain and in adjacent regions. The convex, conical, and barrel-shaped mugs (Types 1.A–C) and pots (Types 3.A–B and 3.D), convex, conical, flaring, globular, and flat bowls (Types 2.A, 2.D–E, 2.H), jars (Type 4), pedestalled vessels (Type 7), and lids (Type 8) are common pottery forms at the sites of the Tisza–Herpály–Csőszhalom complex (e.g., Bánffy and Bognár-Kutzián 2007; Kalicz and Raczky 1984; Korek 1989; Raczky 1992; Raczky et al. 2007; Sebők 2007; Tálas and Raczky 1987). The rectangular bowls on straight runner legs (Type 2.F) also have antecedents in the previous period; grain storage vessels and "altars" of a similar shape were recovered at Tisza sites in the southern Great Hungarian Plain (e.g., Banner 1931). The best analogy occurs in a potential cult assemblage from the nearby Vésztő-Mágor tell site (Hegedűs and Makkay 1987:99). A number of vessel types, such as collared mugs (Type 1.D) and bowls with more complex profiles (Types 2.B–C and 2.G), commonly were produced at Lengyel, Vinča, and Salcuţa sites during the Late Neolithic and Early Copper Age (e.g., Burić and Težak-Gregl 2009:92, Figures 1–2, 98, Figure 13; Chapman 1981:172–73, Figure 3; Radu 2002:Tables 33–35; Schier 1996; Tringham et al. 1992:374, Figure 10). Perforated vessels (Type 6) also occur at Late Neolithic settlements on the Great Hungarian Plain (e.g., Kalicz 1985a:51, Figures 5–6).

When the Bikeri ceramic assemblages are compared to other Tiszapolgár assemblages published in excavation reports and synthetic volumes (e.g., Bognár-Kutzián 1963, 1972; Diaconescu 2009; Goldman 1977; Mészáros 2007; Siklódi 1983, 1984; Szabó 1934; Szilágyi 2010), beyond the overall similarities in terms of vessel types, decoration techniques, and motifs, remarkable differences also can be noticed. Vessel forms at the Bikeri sites that are unknown or rare at other Tiszapolgár sites include collared mugs (Type 1.D), rectangular bowls on straight runner legs (Type 2.F), pots supplied with lug-spouts (Type 3.C), and perforated vessels (Type 6). In addition, several subvariants—many of them common at the Bikeri sites—also are unknown or occur only sporadically in other Tiszapolgár assemblages (e.g., Types 1.B.b, 2.C.a, 3.A.c). By contrast, several ceramic forms that are common at other Early Copper Age sites on the Great Hungarian Plain, such as some jug types (Bognár-Kutzián Type F), pedestalled jars (Bognár-Kutzián Type J), and globular vessels (Bognár-Kutzián Type N), are absent in the Bikeri assemblages. Thus the typological analysis of the Bikeri assemblages indicates local-scale community preferences and peculiarities in ceramic production within the broader, regional Tiszapolgár tradition.

With regard to their overall functional composition, the Bikeri assemblages are very similar; the assemblages include a variety of vessel types, ranging from small serving vessels through cooking pots to large storage vessels.

But distinctive variation occurs in the relative frequency of different ceramic types between the two settlements. In the Körösladány-Bikeri assemblage, mugs are the most common types, whereas at Vésztő-Bikeri bowls constitute nearly half of the identifiable specimens and the representation of mugs is much lower (see Table 9.4). When combined, however, the frequency of these serving vessels is almost identical at the two sites: 53.5 percent at Vésztő-Bikeri and 54.4 percent at Körösladány-Bikeri. At Körösladány-Bikeri, the proportion of pedestalled vessels and lids is slightly higher than at Vésztő-Bikeri, while in the Vésztő-Bikeri assemblage, pots are more common than at Körösladány-Bikeri. Furthermore, several variants occur in markedly different proportions: the overwhelming majority of rectangular bowls on straight runner legs (Type 2.F) and each of the square pedestal bases were found at Vésztő-Bikeri, while bowls with S-shaped upper profiles (Type 2.C.b) were recovered in a much larger proportion from Körösladány-Bikeri. Vessel types from Early Copper Age graves at both sites (see Chapters 7 and 16, this volume) represent the same forms as those found in settlement contexts. However, tumblers appear to be more common in burial contexts.

In an attempt to understand differences in the abundance of major vessel types at the Bikeri sites, multiple interpretations must be considered. Based on the similar layout and features (for example, wells, pits, and enclosures), as well as the co-occurrence of common vessel forms and other artifact types related to household activities (such as grinding stones, lithics, and loom weights; see Chapters 12 and 13, this volume), a functional distinction between the two sites is difficult to entertain; both sites seem to have been small, permanent, residential villages. The differences may indicate different activities reflected in the different contexts excavated at the two Early Copper Age sites (see Chapters 7 and 8, this volume). Alternatively, because the settlement at Körösladány-Bikeri was used primarily following the abandonment of Vésztő-Bikeri (see Chapter 8, this volume), the typological variations in the assemblages may relate to stylistic transformations over time.

Like the vessel forms, the types, combinations, and locations of decorative elements on the ceramics appear to have followed canonical standards at the Bikeri sites. Plastic appliqués that prevail in the assemblages have antecedents in the Late Neolithic on the Great Hungarian Plain; for example, semi-pointed and pointed pierced lugs were produced already in Herpály contexts. However, the distinctive dotted incisions became predominant only at the beginning of the Copper Age. The incised decorative motifs at the Bikeri settlements, including complex linear motifs, regularly occur at sites assigned to the Kisrétpart group of the Tiszapolgár culture (Bognár-Kutzián 1972; Siklódi 1982, 1983, 1984; Szabó 1934; Szilágyi 2015). The proportion of incised sherds, however, is two times more common at Vésztő-Bikeri than at Körösladány-Bikeri (see Table 9.6). On the one hand, this marked difference may be attributed to differences in the abundance of vessel types in the assemblages. Specifically, those types that are more commonly decorated with incisions, particularly bowls, occur in a remarkably lower proportion in the Körösladány-Bikeri assemblage than in that of Vésztő-Bikeri. On the other hand, it is plausible that the differential abundance of incisions indicates diachronic changes in the application of decorative techniques. This latter explanation is supported by the two times higher frequency of linear incisions and the two times lower frequency of dotted incisions in the Körösladány-Bikeri assemblage compared to Vésztő-Bikeri (see Table 9.7). Additionally, the stylistic attributes of linear incised motifs—particularly the crosshatched panels and bands alternating with void zones (Figure 9.35J–K)—that occur exclusively at the younger Körösladány-Bikeri site correlate with the Bodrogkeresztúr decorative style, traditionally assigned to the Middle Copper Age (Bognár-Kutzián 1963; Patay 1974). Similar decorations, however, are evident from other Tiszapolgár—especially Kisrétpart group—settlements (Bognár-Kutzián 1972; Szilágyi 2015). Dates from the Körösladány-Bikeri settlement correlate well with the recently revised chronology for the emergence of Bodrogkeresztúr ceramic style; the earliest burials with characteristic Bodrogkeresztúr ceramics date to circa 4300 cal BC on the Great Hungarian Plain (Csányi et al. 2009; Raczky and Siklósi 2013).

Not only the shifts in proportions of these high-visibility decorative elements but also the alterations in the attributes of the low-visibility motifs might be the result of diachronic changes in ceramic manufacturing practices during the Early Copper Age in the Körös region. In respect to low-visibility decorative elements, some lug attributes also should be noted. Lugs with beaked, ovate-vertical, and semi-pointed cross-sections occur more frequently at Körösladány-Bikeri (see Figure 9.31E–J; Tables 9.9-9.10). By contrast, lugs with round (see Figure 9.31A–C) and rectangular bases (see Figure 9.32A), which regularly were applied during the Neolithic, are much more common at the older Vésztő-Bikeri site. These differences are even more striking when the lower frequencies of vessels typically decorated with these elements (bowls and pots) in the Körösladány-Bikeri ceramic assemblage also are considered. Regarding the frequency of decorations of lugs, however, the two Early Copper Age assemblages are very similar (see Table 9.11).

The overall similarity of the Bikeri assemblages is particularly compelling when the stylistic results are compared to the outcomes of the statistical analysis of the ceramic assemblage from Szolnok-Zagyvapart (Szilágyi 2010). This enclosed Tiszapolgár settlement is located in the middle Tisza region, about 90 km northwest of Vésztő, and is the single Early Copper Age site outside the Körös region on the Great Hungarian Plain with a published dataset that permits comparison. At Szolnok-Zagyvapart, dotted and linear incisions occur on 25.7 percent of the diagnostic ceramics, as opposed to 9.2 percent at Vésztő-Bikeri and 4.7 percent at Körösladány-Bikeri. The proportions of various lug base and cross-section shapes also exhibit very different patterns, with a much higher abundance of round bases, as well as pointed and beaked cross-sections, and significantly lower percentages of ovate-horizontal bases and semi-pointed cross-sections at Szolnok-Zagyvapart. Furthermore, plain lugs occur nearly two times more frequently and semi-pierced specimens two times less frequently at that site than at the Bikeri villages. The unpublished results of statistical analyses on the typically small assemblages of some additional sites in the middle Tisza region indicate significant variability in regard to the proportions of most stylistic variables (Szilágyi 2015). Similar to vessel forms, these markedly different patterns in the abundance of decorative motifs imply diverse micro-traditions throughout the Great Hungarian Plain during the Early Copper Age.

Some rare decorations may indicate latent Neolithic traditions, local-scale manufacturing practices, or interactions with communities living in or outside the Körös region. Judging by the vessel forms and decorative motifs, however, it is difficult to identify "imported" wares in the Early Copper Age ceramic assemblages of the Great Hungarian Plain, as in the case of the Bikeri assemblages. This is because many of the neighboring contemporary cultural units, such as Lengyel, Salcuţa, and Petreşti, produced many similar vessel types.

Painted ceramics are scarce at Tiszapolgár settlements (e.g., Goldman 1977:Figures 7 and 11; Iercoşan 2002:142; Mészáros 2007:88), as well as at Bodrogkeresztúr sites (e.g., Raczky 1991:329–31). As in the Körösladány-Bikeri assemblage, these sherds account for 0.4 percent of the diagnostic ceramics at Szolnok-Zagyvapart (Szilágyi 2010). The presence of painted vessels at Early Copper Age sites has been interpreted as evidence for the persistence of Late Neolithic (Herpály) traditions or as the manifestation of interregional trade contacts with Transylvania, Transdanubia, or the Balkans (Bognár-Kutzián 1972:135; Ecsedy 1981:77; Raczky 1982; Siklódi 1983:17, 1984:42, 53). Using petrographic analyses, we compared six painted sherds with 10 presumably locally manufactured ceramics decorated with typical Tiszapolgár motifs from the Bikeri assemblages. The results of the investigation, performed by Attila Kreiter, verified identical compositional and textural attributes in each case, suggesting that the ceramics were produced in the Körös region (Gyucha and Parkinson 2013; see also Chapter 10, this volume). Thus, the analyses confirmed that the presence of painted vessels alone does not imply interregional interactions. Instead, it can be regarded as an additional element that continued local Late Neolithic pottery manufacturing traditions. In addition, the occurrence of vessels with white paste incrustation without incisions at both Vésztő-Bikeri and Vésztő-Mágor—unknown from other Tiszapolgár sites on the plain—indicates that this particular decoration technique might have developed locally during the Early Copper Age.

Our regional-scale ceramic analysis, utilizing samples from systematic surface surveys and excavations at 23 Early Copper Age sites across the Körös region, suggested that the geographic distribution of most stylistic attributes exhibits uniform or random patterns, indicating intensive interactions among neighboring Tiszapolgár communities (Gyucha 2015; Parkinson 2006a, 2006b). The geochemical analyses of ceramic and clay samples from and around several Early Copper Age sites supported this conclusion (see Chapter 10, this volume). By contrast, several high-visibility ceramic stylistic attributes display a clear fall-off pattern within the Körös region. Highly visible attributes, such as incised decoration, make up of 50–70 percent of the diagnostic assemblages in the western Körös region near the Tisza confluence. There is a marked decline in the frequency of these attributes toward the eastern Körös region, where the abundance of incised decorations consistently remains under 10 percent. In fact, incisions typically amount to 0–1 percent of the diagnostic assemblages at sites located in the easternmost section of the region. In an attempt to offer an explanation of this fall-off pattern, we have suggested that the geographic distribution of these high-visibility attributes is indicative of permeable boundaries between neighboring Early Copper Age communities (Gyucha and Parkinson 2013).

Conclusions

The ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri are very similar in many respects: the same manufacturing procedures, the same vessel types, and the same decorative techniques were applied at both sites. As with many other archaeological indicators, such as settlement layout, stratigraphy (see Chapter 8, this volume), and other aspects of material culture (see Chapters 10 to 15, this volume)—all of which indicate striking similarities between the two neighboring sites—the picture that emerges from the ceramic analysis is that of permanent residential settlements used by groups of sedentary agropastoralists. The high degree of similarity between the ceramic assemblages at the two Bikeri sites—from very visible attributes (such as decoration types) to subtle, less visible attributes (such as rim thickness)—leads us to infer that these assemblages were produced by subsequent generations of the same community.

The assemblages indicate the persistence of Late Neolithic ceramic traditions into the Tiszapolgár phase, suggesting that the changes that mark the beginning of the Copper Age on the Great Hungarian Plain were driven principally by internal developments. The lack of clear ceramic imports from remote regions at the Bikeri settlements, however, suggests a substantial decrease in the degree of interregional interaction compared to the previous period. This process also is reflected in the chipped stone and grinding stone assemblages of Vésztő-Bikeri and Körösladány-Bikeri (see Chapters 12 and 13, this volume).

The Early Copper Age Tiszapolgár culture traditionally is characterized by stylistic homogeneity in ceramic assemblages, at least compared to the Tisza–Herpály–Csőszhalom complex of the Late Neolithic, but comparisons of the Bikeri sites with contemporaneous assemblages from the middle Tisza region demonstrate the coexistence of different local pottery traditions. The analysis of the Bikeri assemblages also permits us to identify subtle temporal variability in ceramic assemblages within the Tiszapolgár period. The initial occurrence of some Bodrogkeresztúr elements at Körösladány-Bikeri can be interpreted as an indicator of the gradually altering stylistic preferences of a single community over the course of the Early Copper Age.

Chapter 10

Elemental, Mineralogical, and Petrographic Analyses of Ceramics and Daub

Samuel Duwe, Timothy A. Parsons, Michael L. Galaty, and Hanneke Hoekman-Sites

To measure interaction and exchange between Early Copper Age communities in the study area of the Körös region, Duwe, Parsons, and Galaty conducted elemental, mineralogical, and petrographic analyses of samples of ceramic sherds and pieces of burned daub from the Tiszapolgár sites of Vésztő-Bikeri and Körösladány-Bikeri. Samples from five other contemporaneous settlements (Battonya-Vertán, Endrőd-Hegedűs-tanya, Gyula-Remete-Iskola, Örménykút-Maczonkai-domb, and Vésztő-Mágor) also were analyzed to assess the level of interaction among Tiszapolgár communities in and around the Körös region (Duwe 2005; Parsons 2005). In an attempt to identify evidence of dairying and animal product use at the sites, Hoekman-Sites also examined residues on ceramic samples from Vésztő-Bikeri and Körösladány-Bikeri (Hoekman-Sites et al. 2006).

To characterize Early Copper Age ceramics and better understand the levels and sources of compositional variability, it was necessary first to establish the extent of clay mineralogical and chemical variation across the study area. When these data were combined, it was possible to determine if Early Copper Age ceramics were exchanged and to assess the levels of interaction among settlements.

The study area is composed of homogeneous geological deposits of alluvially transported loess (Parkinson 2006a; Szakmány and Starnini 2007; see also Chapter 2, this volume). However, the primary and secondary drainage systems in the Körös River and Maros River basins introduce a certain amount of measurable variability. These rivers and their smaller tributaries originate and flow through different geological regimes in the Carpathian Mountains, east of the study area. They carry different sediment loads composed of different minerals of different sizes and have formed clay deposits with different chemical compositions. These fluvial processes account for enough mineral and chemical variation in our sampled clay sources to distinguish between locally made and nonlocal ceramic vessels in assemblages from the studied Early Copper Age sites.

Once the regional compositional variation of clay was established, it was possible to address the second goal: to determine the degree and sources of ceramic compositional variability. Ceramic compositional data were compared to geological data to establish whether ceramics were exchanged between settlements during the Early Copper Age. "Ceramic mobility" (the relative frequency of local and nonlocal ceramics in site assemblages and the distance between clay sources and sites) can be interpreted as a proxy for social interaction (Spielmann 1994; Zedeño 1994). Understanding the degree and direction of ceramic mobility has broad implications for interpreting social boundaries and human movement during the Neolithic–Copper Age transition (Parkinson 2006a, 2006b).

Analytical Methods

The complementary analytical techniques of petrographic analysis, instrumental neutron activation analysis (INAA), and time of flight-laser ablation-inductively coupled plasma-mass spectrometry (TOF-LA-ICP-MS) were used to address these research goals and questions. Besides providing baseline data to be used in future research, the broad clay and ceramic compositional variability across the study area was established, and some patterns of Early Copper Age social interactions in the Körös River basin were revealed.

Mineralogical Characterization Analysis

The petrographic study of samples of ceramics from sites in the study area operated under the guiding principle that sherds from the same site can differ in internal mineral composition while appearing identical to the unaided eye (Hoekman-Sites et al. 2006; Michelaki 1999; Parsons 2005). Likewise, clays from different sources were expected to have different internal mineral compositions. In the end, petrographic analysis helped us describe intersite and intrasite ceramic fabric and clay variability, and led us to suspect that different clays were used to manufacture different vessels, which were exchanged between sites. This was possible because petrographic research allows for both qualitative and quantitative analyses of clays and ceramic fabrics. A petrographer may describe the qualitative characteristics of a pot or clay, such as its optical reactivity, birefringence, and mineral constituents, but also may collect quantitative data, such as the ratios of sand, silt, void space, and matrix in various vessels or clays. Such analyses can answer questions about how a pot was made, its function, and, in some cases, the production provenience.

Understanding the observed patterns in petrographic data requires one to account logically for different possible past behaviors. For example, the identification of several distinct ceramic fabrics or variations in paste composition could indicate the presence of several potters in a settlement either simultaneously or over a period of time, the use of different clays or a combination of clays by different potters or a single potter, or trade relationships with other settlements that employed different ceramic manufacturing technologies. On the other hand, little or no variation in ceramics gathered from one (or more) sites poses an entirely different set of questions that are more difficult to answer, since it is extremely unlikely that a single potter gathering clay from a single source manufactured pottery for sites in an entire settlement system. Possible explanations include extremely similar production techniques and technology or simply widespread geographic homogeneity in clay sources that obscures the movement of ceramic vessels across the landscape.

Thin Sections

Eighteen thin sections were made from 15 sherds (one from Körösladány-Bikeri, seven from Vésztő-Bikeri, two from Örménykút-Maczonkai-domb, and five from the Vésztő-Mágor tell site) and from three daub samples from Vésztő-Bikeri. To maintain chronological control, ceramic samples were taken from diagnostic sherds that were clearly associated with the Tiszapolgár culture of the Early Copper Age (for example, pierced pedestal bases, lugs, and decorated body sherds). The samples were from sherds fired in various states of reduction, and the majority of samples were burnished. The daub samples were used as a proxy for naturally occurring clay, for it is assumed that daub is procured from soils adjacent to the domestic site. Each sample was impregnated with epoxy, mounted onto a glass slide, ground to a thickness of 2–3 microns (0.02–0.03 mm), and cover-slipped. Analysis was conducted with a polarizing microscope under both plane polarized light and cross-polarized light. For each thin section, micro-structure, ground mass, and color were recorded using Whitbread's (1995:Appendix 3) terminology and methodology. A digital mechanical stage was used for precise point counting, and counts were made at 2 mm intervals. Point counting was performed blind to ensure objectivity. Following Stoltman's (1989) methodology, the proportions of matrix–temper–sand were point counted to describe a vessel's clay body, and proportions of matrix–silt–sand to describe a vessel's paste. None of the vessel samples appear to have been intentionally tempered, but clay pellet inclusions were present in all the ceramic samples. Lacking the sharp angular characteristics and void space typically associated with grog, they are thought to be small fragments of clay not crushed during processing.

Petrographic analysis did not reveal any significant distinctions between ceramic samples taken from the four sites in the study area (Table 10.1) and provided little support for mineral and clay compositional variability across the region. This is because very few detrital minerals were identified in the thin sections. Minerals identified, in order of density, were quartz, muscovite mica, occasional chert, and negligible amounts of calcite and sandstone.

The sand–silt–matrix (paste) ratio for each sample is shown in Figure 10.1. The sand–temper–matrix (body) ratio for each sample is shown in Figure 10.2. For analytical purposes, clay pellets were classified as temper. In the petrographic analysis, pottery and daub are virtually indistinguishable in terms of paste composition. This indicates

Table 10.1. Point count data from 18 ceramic and daub samples in the study area that were subjected to petrographic analysis

Sample Number	Site	Type	Paste			Body		
			% Matrix	% Silt	% Total Sand	% Matrix and Silt	% Sand	% Temper
1	Körösladány-Bikeri	ceramic	82.0	16.5	1.5	88.0	1.4	10.6
2	Örménykút-Maczonkai-domb	ceramic	75.5	16.5	8.0	90.8	7.8	1.4
3	Örménykút-Maczonkai-domb	ceramic	74.4	24.1	1.5	91.0	1.4	7.6
4	Vésztő-Mágor	ceramic	78.8	19.7	1.5	94.4	1.4	4.2
5	Vésztő-Mágor	ceramic	80.0	17.0	3.0	96.0	3.0	1.0
6	Vésztő-Mágor	ceramic	82.0	14.5	3.5	94.5	3.4	2.1
7	Vésztő-Mágor	ceramic	81.4	17.8	0.8	95.0	0.7	4.3
8	Vésztő-Mágor	ceramic	83.3	15.2	1.5	92.0	1.4	6.6
9	Vésztő-Bikeri	ceramic	87.0	13.0	0.0	91.0	0.0	9.0
10	Vésztő-Bikeri	ceramic	81.3	15.2	3.5	95.2	3.4	1.4
11	Vésztő-Bikeri	daub	83.6	14.9	1.5	0.0	0.0	0.0
12	Vésztő-Bikeri	daub	86.4	11.3	2.3	0.0	0.0	0.0
13	Vésztő-Bikeri	daub	85.3	11.4	3.3	0.0	0.0	0.0
28	Vésztő-Bikeri	ceramic	86.3	11.0	2.7	96.5	2.0	1.5
29	Vésztő-Bikeri	ceramic	85.5	13.1	1.4	0.0	0.0	0.0
30	Vésztő-Bikeri	ceramic	84.5	13.2	2.3	95.0	2.1	2.9
31	Vésztő-Bikeri	ceramic	81.6	17.6	0.8	93.2	0.6	6.2
32	Vésztő-Bikeri	ceramic	84.2	15.8	0.0	99.2	0.0	0.8

Table by Timothy A. Parsons and Michael L. Galaty.

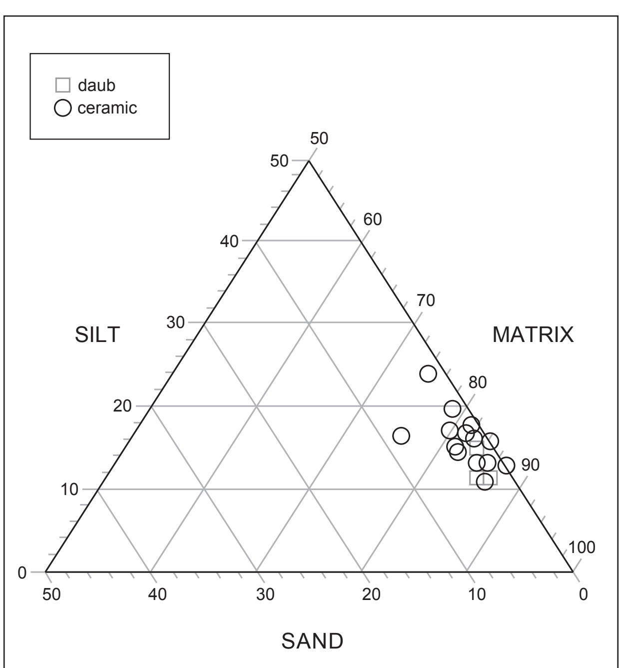


Figure 10.1. Paste constituents for all petrographic samples. *Figure by Timothy A. Parsons and Michael L. Galaty.*

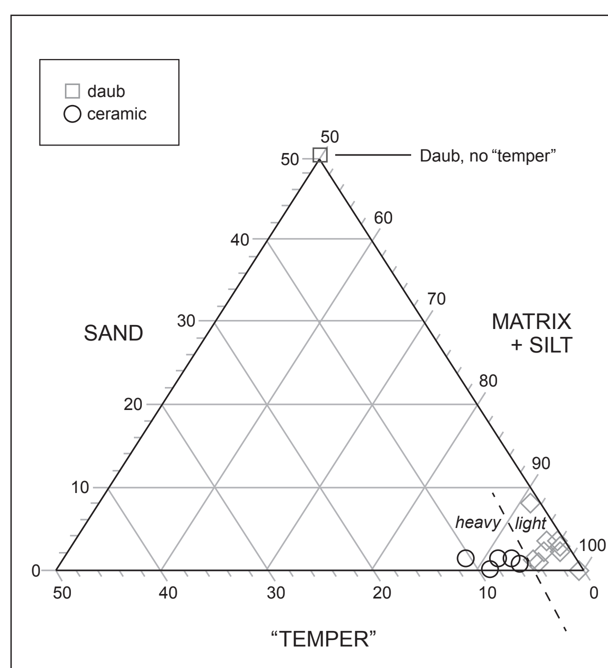


Figure 10.2. Tri-graph of body composition for all samples. *Figure by Timothy A. Parsons and Michael L. Galaty.*

that pottery from all four studied sites was manufactured from nearly identical local clays. Pottery and daub are clearly differentiated, however, in terms of their different qualitative characteristics, such as the number and shape of void spaces.

Different pottery samples include different numbers of clay pellets, roughly characterized in Figure 10.2 as light (containing less than 5 percent unpulverized clay pellets) and heavy fractions (containing more than 5 percent unpulverized clay pellets). The light fraction contained temper percentages of 5 percent or less, ranging from 1 to 5 percent, whereas the heavy fraction ranged anywhere from 6 to 11 percent. The daub samples contained either negligible numbers of clay pellets or none at all and are not included in either fraction. Only one ceramic sample lacked clay pellet inclusions. It seems likely that the degree to which samples were tempered with clay pellets is the result of different preparation techniques on the part of different potters, such as in the amount of clay wedging used. Differences in body composition did not vary regionally. Potters at different sites may have employed slightly different clay-wedging techniques and/or these techniques may have changed through time, but the different recipes do not seem to have been linked to regionally specific traditions.

The three daub samples varied greatly in qualitative description but produced almost identical quantitative results, except for one that contained significantly less void space than the others. It may be that the aberrant sample was a section of a clay loom weight—which closely resembles the unfired daub used in house construction—rather than structural daub. More so, the voids in this sample resemble vughs (relatively large, irregular void spaces; see Whitbread 1995:380), while void spaces in other daub samples included both vughs and channels (channels may be linear in thin section but are cylindrical in three dimensions; see Whitbread 1995:380). Channels result from the inclusion of organic material during the construction of a wattle-and-daub structure. Only two ceramic samples could be considered outliers (Figure 10.1); both were from the Örménykút-Maczonkai-domb site. Interestingly, although both samples appear very similar when evaluated qualitatively (they have the same mineral inclusions, including an unidentified opaque material), they differ quantitatively. One is quite sandy, more than any of the other samples, and one is siltier. This difference in the Örménykút-Maczonkai-domb samples is visible even macroscopically. This makes them quite different from all the other samples, which are identical when examined macroscopically. Results of petrographic analysis lead us to suggest that pottery and clays from the southwestern portion of the study area—near and from the region of the Maros Fan—vary in terms of grain-size composition and distribution (that is, in the amount of silt and sand identifiable in thin sections and macroscopically). These regional differences are more pronounced when the chemical compositions of the ceramic and daub samples are analyzed.

All the petrographic samples fit within a relatively narrow range of similar characteristics. The matrix is relatively fine and very homogeneous, containing very little sand and only moderate amounts of silt. Based on these results, petrographic analysis does not provide direct and unambiguous evidence for the existence of an extensive pottery trade network and instead suggests that during the Early Copper Age, potters gathered local clays and produced pottery for primarily local consumption, and that their pots were exchanged, but rarely.

Additional Petrographic Analysis of Painted Ceramics

Painted ceramics are extremely rare finds at Tiszapolgár settlements. Though rare, they are cited as evidence for continuity with Late Neolithic ceramic traditions or for interregional interaction or trade contacts with neighboring regions, such as Transdanubia or the Balkans (for discussion and references, see Chapter 9, this volume).

The mineral composition of six painted sherds from Vésztő-Bikeri and Körösladány-Bikeri was compared to a selection of 10 typical Tiszapolgár sherds that were thought to have been produced locally at the two sites. The results of petrographic analysis performed by Attila Kreiter revealed that the compositional and textural attributes in all samples were identical. This indicates that all the 16 analyzed ceramic fragments are from vessels manufactured in the study area (Gyucha and Parkinson 2013; see also Chapter 9, this volume). These analyses confirmed that, like other Tiszapolgár pottery types, painted ceramics were not exchanged over great distances during the Early Copper Age in the Körös region.

Table 10.2. Sample set of daub and ceramics from four sites in the study area analyzed by INAA

Site	Daub	Ceramics	Total
Körösladány-Bikeri	0	1	1
Örménykút-Maczonkai-domb	0	2	2
Vésztő-Bikeri	11	7	18
Vésztő-Mágor	0	3	3
Total	**11**	**13**	**24**

Table by Samuel Duwe.

Chemical Characterization Analyses

Both INAA and TOF-LA-ICP-MS were used in the chemical characterization analyses of Early Copper Age pottery from the study area to refine the general patterns found in the petrographic data.

In a preliminary project, 24 ceramic and daub samples from four sites (Table 10.2) were processed and submitted for INAA to the Phoenix Memorial Laboratory at the Ford Nuclear Reactor, formally located at the University of Michigan (Duwe 2005). We found considerable regional compositional differences when comparing daub samples from Vésztő-Bikeri to those from two Bronze Age sites from the Maros River drainage (Klárafalva-Hajdova and Kiszombor-Új Élet Tsz., expressed as 90 percent confidence ellipses, analyzed by Michelaki 1999), located circa 100 km southwest of Vésztő-Bikeri.

Within a considerable distance across the Great Hungarian Plain, the chemical composition of the daub samples—and likely the local clay—is variable enough to form distinguishable and non-overlapping patterns (Figure 10.3A). To test the degree of chemical variation between sites within the Körös River drainage, ceramic samples from four sites—Vésztő-Bikeri, Körösladány-Bikeri, Örménykút-Maczonkai-domb, and the Vésztő-Mágor tell—were compared. Although not forming distinct groups, ceramic samples did cluster by site (Figure 10.3B). The samples from Örménykút-Maczonkai-domb were found to be different from the three other, closely spaced settlements, reinforcing the results of the petrographic analysis. The clay of the Körös River basin is homogeneous enough over 35 km (the maximum distance between analyzed sites) to produce broadly similar chemical composition in the clay samples and ceramics, yet there are subtle differences between sites.

To further investigate regional variation in clay chemical composition, TOF-LA-ICP-MS was used to analyze archaeological and mineral samples from the study area. Although this technique has been shown to have a lower level of precision than some other chemical techniques, such as INAA (Durrant and Ward 1993), TOF-LA-ICP-MS allows for the rapid processing of samples and hence larger datasets (Duwe and Neff 2007; Neff 2003).

The dataset consists of 276 ceramic, daub, and clay samples from six sites in and beyond the Körös Regional Archaeological Project study area: Battonya-Vertán, Endrőd-Hegedűs-tanya, Gyula-Remete-Iskola, Körösladány-Bikeri, Örménykút-Maczonkai-domb, and Vésztő-Bikeri (Table 10.3). The samples were analyzed using a GBC OptiMass TOF-LA-ICP-MS at the Institute for Integrated Research in Materials, Environments, and Societies at California State University–Long Beach. To control for chronology, the sherds sampled in this study were all Tiszapolgár pedestal bases. Clay samples were procured by collecting soil below the plowzone at each site locality. These were formed into tiles, which were then fired in an oven at 800°C at a step rate of 75 degrees per hour. Daub samples were selected from archaeological collections of known provenience. The statistical analyses used to generate these results followed procedures developed for the analysis of INAA data (Glascock 1992), and the analysis follows the procedure detailed by Neff (2002).

To understand the extent of chemical variation across the study area, all clay and daub samples were plotted. Due to the extreme geological homogeneity of the study area, no clear patterning emerged in the statistical analysis. Therefore, the ceramic, clay, and daub samples were compared from each individual site to determine a unique local geological chemical signature. To demonstrate this process at a single site, clay and ceramic samples (no daub was available) from Örménykút-Maczonkai-domb were compared on an elemental bivariate plot of Sb and Cr (Figure 10.4). Twenty-three samples clustered relatively tightly within a group, with higher values of Cr than the second group (n = 7). Because of the similarity of the first group of samples, and due to the group's association with clay samples, this pattern is interpreted as a local ceramic signature, represented by the probability ellipse in Figure 10.4. It appears that most of the non-local ceramics also cluster into a loosely defined group, with one sample not associated with either group. This process also was performed on samples from the other five sites based on the analysis of pottery, clay, and daub on elemental bivariate plots.

To understand how each site relates to each other site over a large area, all the locally produced sherds were plotted as an elemental bivariate plot of Sc by Sn (Figure 10.5). For clarity, the probability ellipses for each site are displayed. It appears that five of the sites (Endrőd-Hegedűs-tanya, Gyula-Remete-Iskola, Körösladány-Bikeri, Örménykút-Maczonkai-domb, and Vésztő-Bikeri) share very similar local signatures. The only site with measurable differentiation is Battonya-Vertán, located farthest from the rest of the sites, outside the Körös region (Figure 10.8). Because the five sites in the Körös River basin share a similar local signature, the local samples from these sites were combined as a supergroup, labeled "Core Local Pottery." Figure 10.6 is an elemental bivariate plot of Sc by Sn illustrating

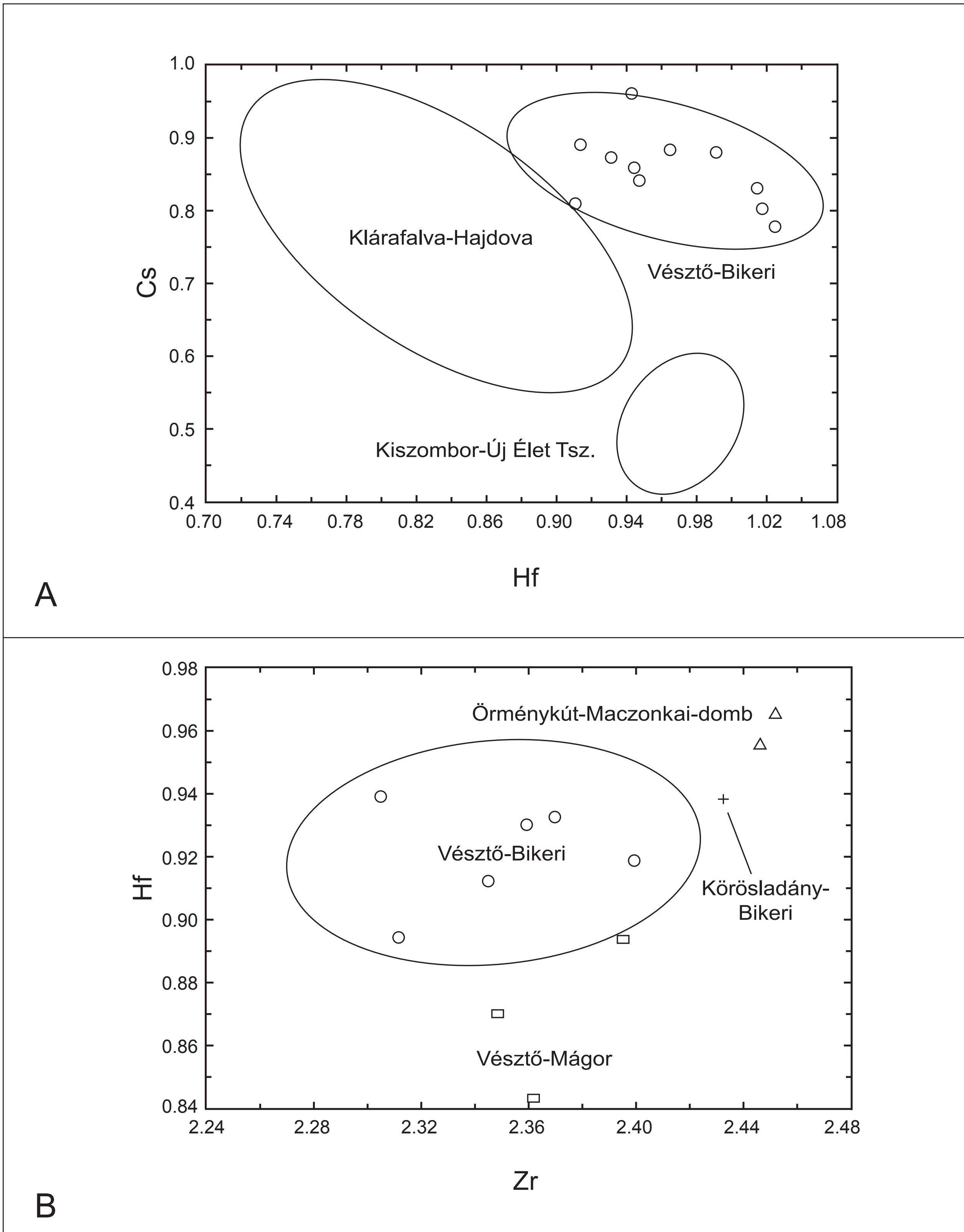


Figure 10.3. The results of the INAA analysis. A: The comparison of daub (representative of clay) samples from Vésztő-Bikeri and Bronze Age sites from the Maros River region (Klárafalva-Hajdova and Kiszombor-Új Élet Tsz.); B: The comparison of sherds from the four analyzed sites in the Körös River basin. All elemental counts are plotted as log values with 90 percent confidence level. *Figure by Samuel Duwe.*

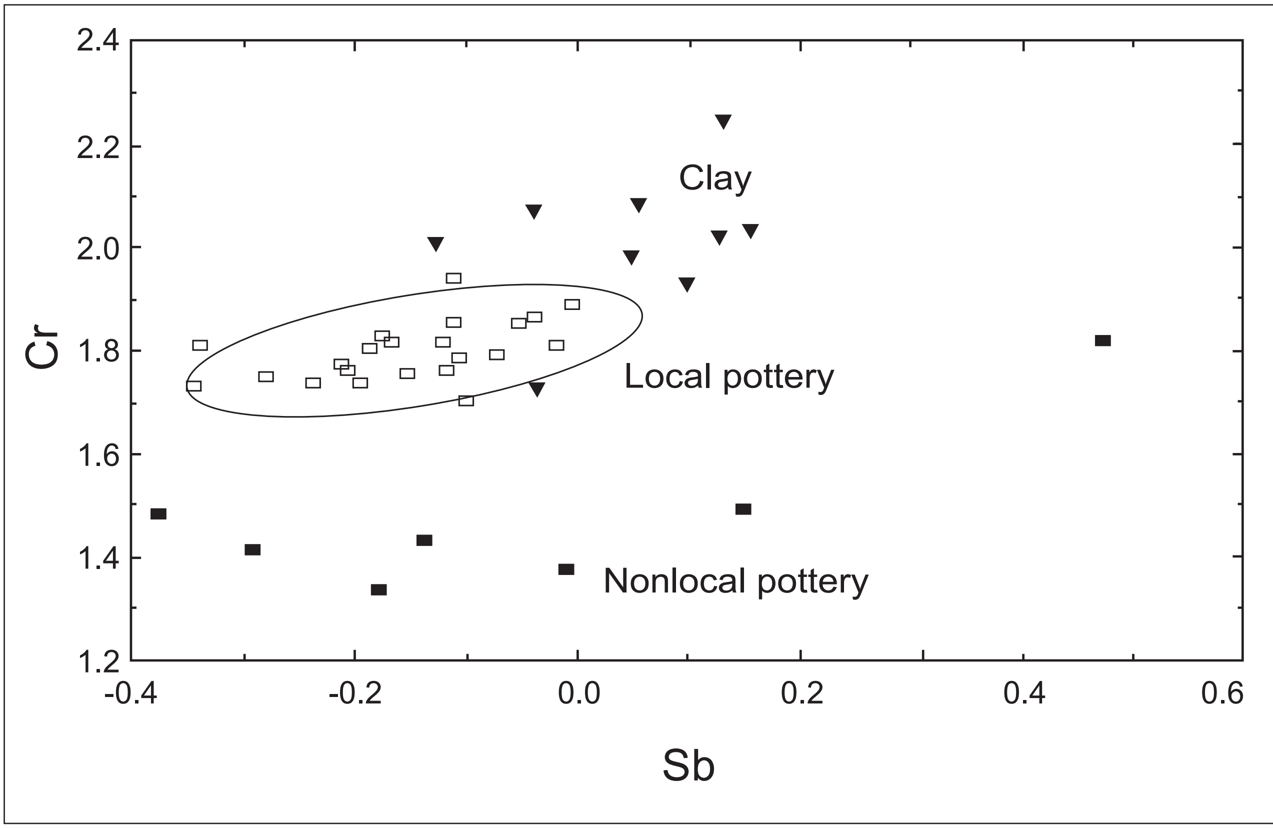


Figure 10.4. Bivariate plot of Sb and Cr (base 10 log concentrations) illustrating local and nonlocal ceramics and clay from Örménykút-Maczonkai-domb. Ellipses represent 90 percent confidence level. *Figure by Samuel Duwe.*

Table 10.3. Sample set of clay, daub, and ceramics from six sites in and beyond the study region analyzed by TOF-LA-ICP-MS

Site	Clay	Daub	Ceramics	Total
Endrőd-Hegedűs-tanya	9	10	30	49
Gyula-Remete-Iskola	9	10	29	48
Körösladány-Bikeri	8	10	29	47
Vésztő-Bikeri	8	8	30	46
Örménykút-Maczonkai-domb	9	0	30	39
Battonya-Vertán	9	8	30	47
Total	**52**	**46**	**178**	**276**

Table by Samuel Duwe.

these two groups, and Table 10.4 presents their elemental concentrations. It appears that across a span of 35 km there is little chemical variation. With this knowledge—and the fact that Battonya-Vertán is located 50 km south of the core area and has a different local compositional signature—we propose a geographical region with a diameter between 35 and 50 km of homogeneous clay on this part of the Great Hungarian Plain. Because five of the sites fall into the Core Local Pottery group, it will continue to be difficult to understand pottery mobility within the Körös region. However, it is possible to model exchange with Battonya-Vertán and with other settlements in areas outside the core area.

Because there appears to be some geological compositional variation across the region, we are able to discuss evidence for the "mobility" of pottery within the

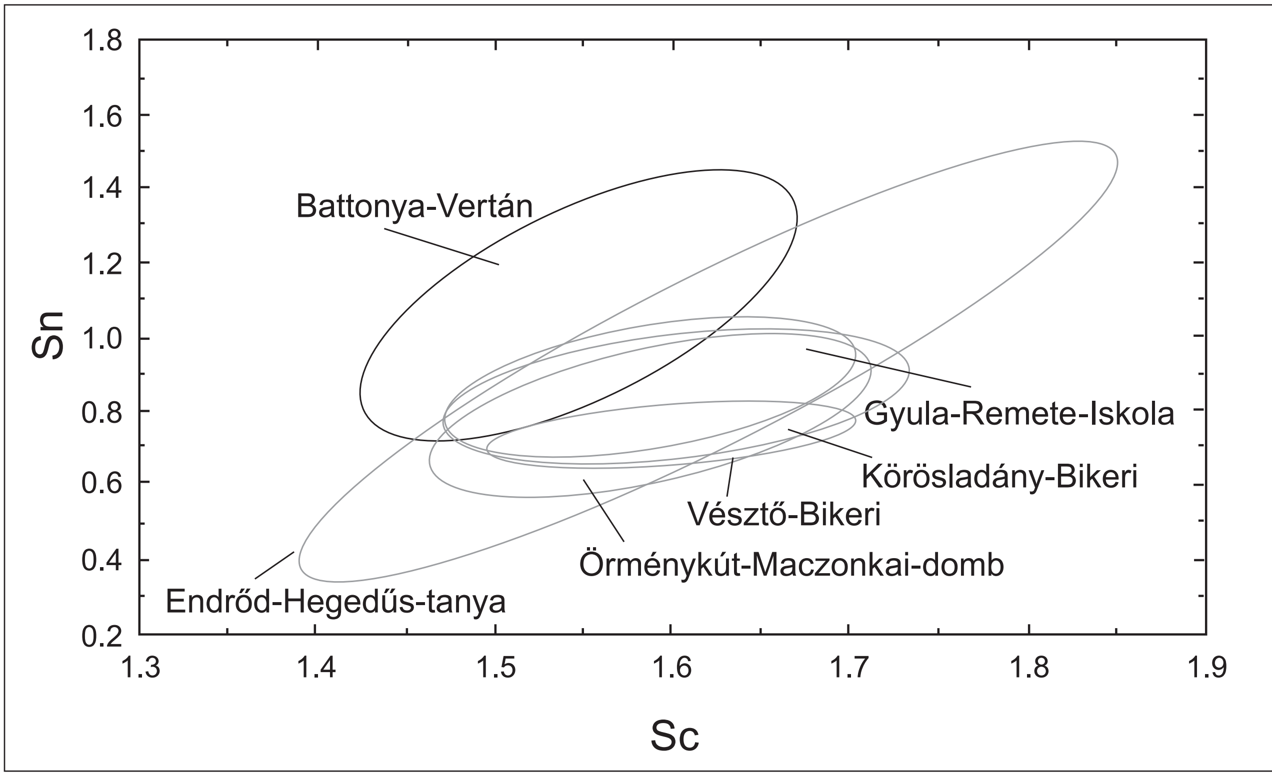


Figure 10.5. Bivariate plot of Sc and Sn (base 10 log concentrations) illustrating local ceramic/clay groups from the six studied sites. Ellipses represent 90 percent confidence level. *Figure by Samuel Duwe.*

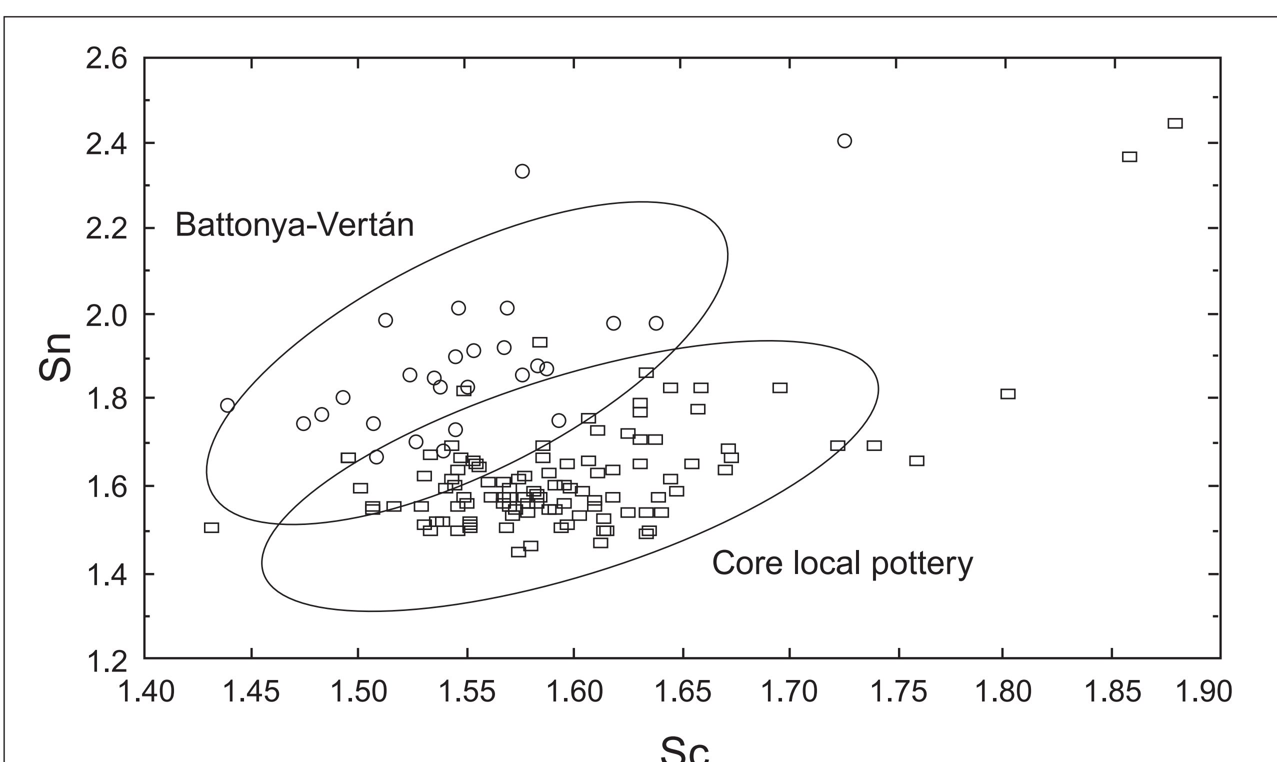


Figure 10.6. Bivariate plot of Sc and Sn (base 10 log concentrations) illustrating major local ceramic/clay groups (Core Local Pottery and Battonya-Vertán) in the studied area. Ellipses represent 90 percent confidence level. *Figure by Samuel Duwe.*

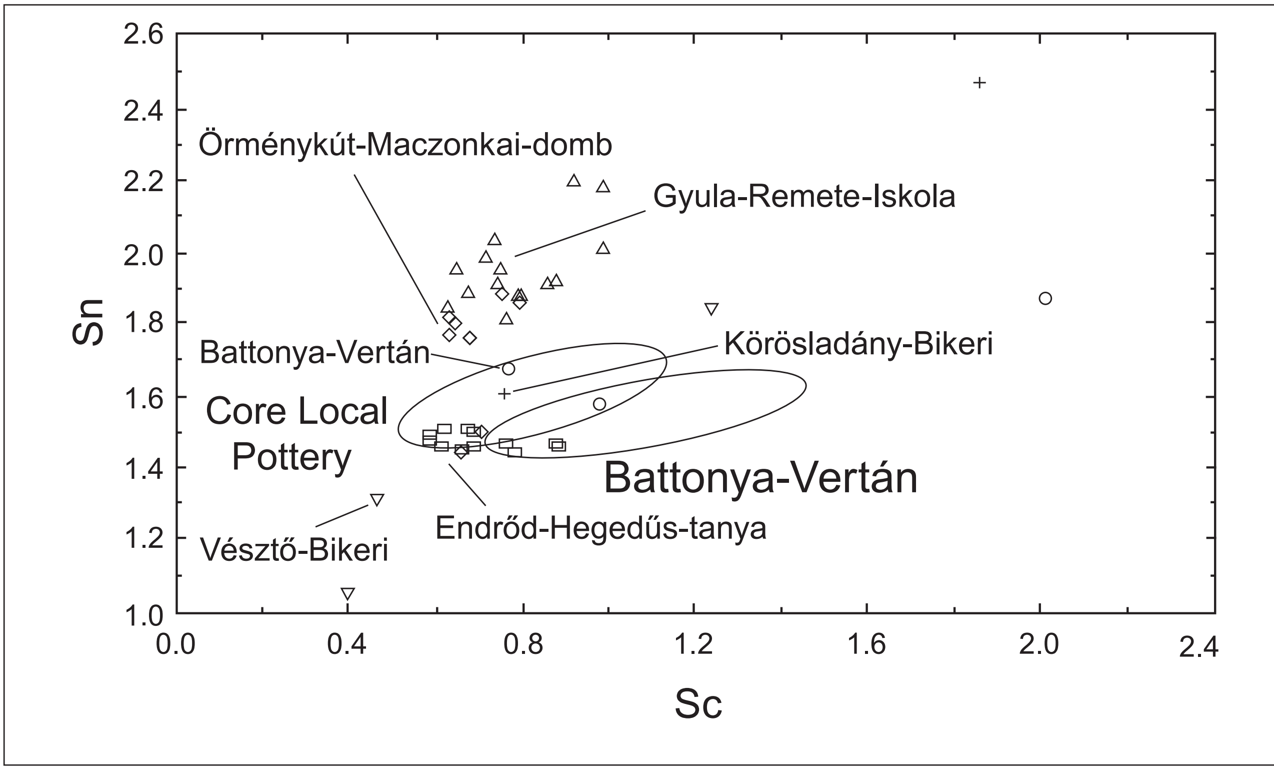


Figure 10.7. Bivariate plot of Sn and Sc (base 10 log concentrations) illustrating major local ceramic/clay groups (Core Local Pottery and Battonya-Vertán) in the studied area. Nonlocal ceramic samples from the six sites are superimposed. Ellipses represent 90 percent confidence level. *Figure by Samuel Duwe.*

study area as well as evidence for imported ceramics from surrounding regions at each sampled site. Our interpretations are based on an elemental bivariate plot of Sn and Sc, with the two local groups represented as ellipses and the nonlocal samples plotted as an overlay (Figure 10.7). A spatial representation of this analysis is presented in Figure 10.8.

Evidence of exchange between sites in the larger region is demonstrated by multiple samples of pottery found at Endrőd-Hegedűs-tanya produced using clays from the Battonya-Vertán group. Mobility appears to have worked in the other direction as well, with a sample of Core Local pottery found at Battonya-Vertán. This provisionally establishes ceramic mobility on a north–south axis, between villages separated by nearly 50 km.

Our data also allow for the interpretation of the extent of exchange with surrounding regions. There are multiple samples from Vésztő-Bikeri, Battonya-Vertán, and Körösladány-Bikeri with an unknown provenience. The most interesting results emerge from Örménykút-Maczonkai-domb and Gyula-Remete-Iskola, where six and 12 imported ceramics cluster tightly together, respectively, suggesting a shared origin. This is further interpreted as indicating interaction with a specific but yet unidentified, extra-local community.

Establishing Regional Compositional Variation

Previous compositional research on ceramics from the Great Hungarian Plain demonstrated the region's geological homogeneity but also revealed slight intraregional variation both mineralogically (Szakmány and Starnini 2007) and chemically (Szakmány et al. 2005). This project has reached similar conclusions. Based on petrographic, INAA, and TOF-LA-ICP-MS analyses, ceramics from all sites in the Körös River basin have very similar mineral and chemical compositions. Clay resources within this area are homogeneous enough to negate any meaningful large-scale research relating to ceramic mobility, although both the petrographic and INAA data suggest that there may be slight intraregional variations.

Table 10.4. Mean elemental composition and standard deviation of the two major clay sources (Core Local Pottery and Battonya-Vertán) in ppm

Element	Core Local Pottery (n = 107)		Battonya-Vertán (n = 27)	
	Mean	Standard Dev.	Mean	Standard Dev.
MG	3,341.272	1,168.392	4,216.287	593.041
AL	93,612.434	11,215.879	107,623.035	9,242.791
SI	326,060.299	19,923.509	290,107.36	12,104.193
K	23,966.127	5,927.924	29,573.762	4,448.733
CA	18,098.01	13,107.756	21,668.32	7,974.218
SC	40.161	7.039	35.812	4.935
TI	6,327.506	2,563.277	5,712.884	1,551.562
V	133.561	31.31	138.857	15.628
CR	101.988	46.017	67.527	39.831
MN	707.54	979.991	730.442	605.609
FE	40,910.219	12,893.826	48,060.047	7,195.472
NI	73.826	27.724	58.451	13.034
CO	18.477	19.26	18.06	5.727
CU	46.737	20.765	32.022	13.266
ZN	181.71	53.101	169.834	33.393
AS	31.488	30.357	15.481	7.243
RB	128.766	26.08	148.654	17.607
SR	170.86	90.433	119.846	26.145
Y	64.283	304.055	44.45	30.481
ZR	335.138	977.254	273.082	439.048
NB	28.535	20.074	31.163	11.274
SN	7.237	4.886	13.237	7.342
SB	0.898	0.566	1.922	0.887
CS	6.042	1.534	7.059	1.092
BA	848.35	591.427	479.417	59.914
LA	41.872	57.928	44.135	31.233
CE	76.724	117.735	74.241	54.353
PR	9.157	11.677	7.833	6.153
ND	51.221	67.968	55.966	38.288
SM	7.405	9.445	5.538	3.653
EU	1.318	1.992	0.762	0.36
GD	10.914	19.71	7.884	6.143
TB	1.136	4.81	0.535	0.44
DY	9.301	45.226	5.113	4.815
HO	1.79	9.535	0.777	0.749
ER	5.345	28.745	2.535	1.802
TM	0.69	4.003	0.271	0.157
YB	5.559	27.589	2.778	1.91
LU	0.603	2.852	0.317	0.246
HF	10.857	32.004	11.216	22.819
TA	1.924	2.428	1.241	0.92
PB	27.785	15.43	20.581	9.131
TH	17.314	17.913	14.863	7.092
U	2.35	2.074	1.627	0.955

Table by Samuel Duwe.

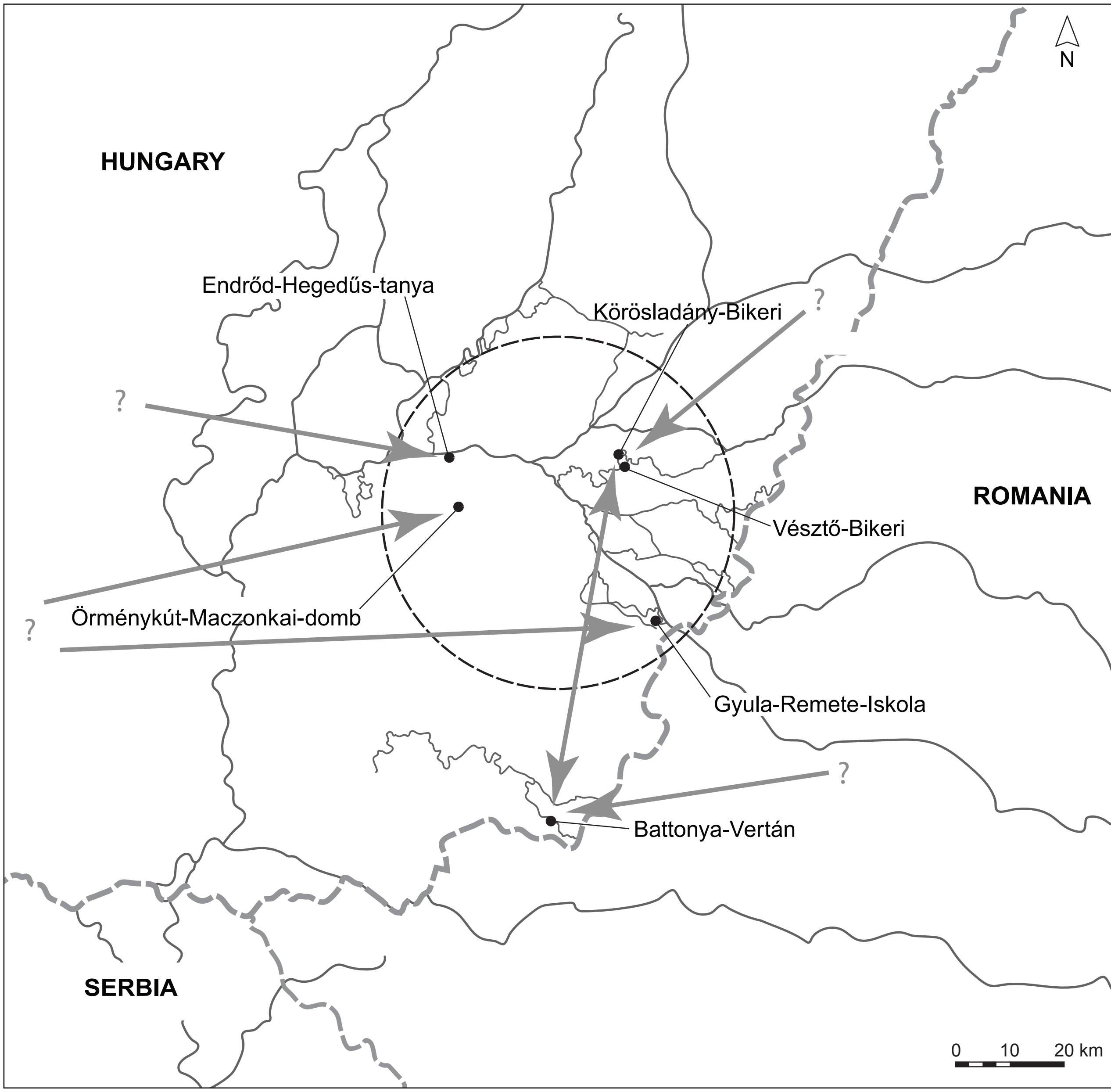


Figure 10.8. Map of the studied area, locations of the six analyzed sites, and probable routes of ceramic mobility. The geographic extent of the Core Local Pottery supergroup is outlined. *Figure by Samuel Duwe.*

When the region is viewed at a broader scale, INAA and TOF-LA-ICP-MS analyses indicate that each river catchment on the Great Hungarian Plain has a unique compositional signature. Based on samples from Battonya-Vertán and two other Bronze Age sites in the Maros River valley (Klárafalva-Hajdova and Kiszombor-Új Élet Tsz.), we conclude that within 50 to 100 km, subtle yet statistically relevant compositional patterning occurs in clay sources. This regional geological variation will allow future research into ceramic mobility between the Körös River basin and surrounding regions.

The Degree and Directionality of Ceramic Mobility

Using ceramic stylistic data, Parkinson (2006a) argued that, compared to the preceding Late Neolithic period, social boundaries had become more fluid and permeable in the Körös region by the beginning of the Early Copper Age, allowing more extensive interaction across larger social networks. While this hypothesis is based on ceramic style, provenance analysis provides a unique opportunity to test the actual movement of pottery across the landscape. While this movement may be indicative of different social behaviors—such as migration, marriage, feasting, or trade—ceramic mobility can be inferred as a proxy for some kind of interaction between different villages and villagers. We do not have compositional data on Late Neolithic pottery, but we are able to assess the validity of several aspects of Parkinson's model.

The chemical compositional data—although obscured by the geological homogeneity of the Körös region—show evidence for ceramic mobility between Early Copper Age sites within the study area. In addition, we were able to verify substantial interaction between contemporaneous sites in the Körös River basin and in surrounding regions. This appears to have occurred to a greater degree in villages located on the edges of the study area (Endrőd-Hegedűs-tanya, Gyula-Remete-Iskola, and Örménykút-Maczonkai-domb). This pattern seems to fit Parkinson's (2006a) model of increased regional interaction across the Great Hungarian Plain accompanied by population dispersion.

As the large, nucleated populations from Late Neolithic villages dispersed across the region, social ties probably remained intact, as reflected by the ceramic record. Locally manufactured pottery was introduced into nonlocal villages by way of population movement or trade, and previous social boundaries became more fluid. The full extent to which these patterns of mobility were altered during the Early Copper Age remains unknown due to a lack of data on Late Neolithic pottery. However, our research has provided baseline data on the region's geographical compositional variation in clay sources, which will be used in future research examining the social implications of ceramic mobility during the Neolithic–Copper Age transition (Hoekman-Sites et al. 2006).

Residue Analyses of Ceramics and Evidence for Dairying at Vésztő-Bikeri and Körösladány-Bikeri

Bökönyi (1974) suggested that the shift in settlement strategies during the Neolithic–Copper Age transition on the Great Hungarian Plain was associated with intensive cattle herding (a local manifestation of the Secondary Products Revolution; see Sherratt 1981, 1983b). He reasoned that larger cattle herds would require more grazing land, so nucleated groups dispersed from Late Neolithic tells and searched for new pastures. This might be one way to explain the Early Copper Age settlement pattern, but analyses of faunal and floral assemblages from the Vésztő-Bikeri and Körösladány-Bikeri villages do not support Bökönyi's model (see Chapters 14 and 15, this volume). Bartosiewicz (2005) demonstrated that the numbers of cattle remains in faunal assemblages from the Great Hungarian Plain increased during the Middle Neolithic and Late Neolithic periods. However, the proportion of cattle remains at both Vésztő-Bikeri and Körösladány-Bikeri decreases slightly compared to the Late Neolithic (see Chapter 14, this volume). Even if Bökönyi's idea is not supported by the Early Copper Age faunal remains of the Körös region, his focus on the impact of shifting animal exploitation strategies is an important, and often ignored, aspect of cultural change in agropastoral societies. Studying how animal utilization patterns changed can help us understand shifts in social organization, since subsistence systems often are linked to specific sociopolitical structures, and transformations in one often result in changes in the other (Hoekman-Sites 2011).

For a long time, it was believed that the agropastoral groups that settled on the Great Hungarian Plain during the Early Neolithic did not use secondary products. Most thought that the Secondary Products Revolution began later (Sherratt 1981, 1983b). Aside from being good sources of meat on demand, what Clutton-Brock (1988) called a "walking larder," secondary products, such as wool, milk, manure, and traction, changed the way early agropastoralists raised their stock. More recent studies have shown that evidence for secondary product use is quite variable (Hoekman-Sites 2011; Hoekman-Sites and Giblin 2012; Marciniak 2011). Adoption and use of these products was a slow idiosyncratic process, not the result of the rapid appearance of a unified secondary products package, as originally proposed by Sherratt (1981, 1983b). In fact, there is evidence for use of dairy products on the Great Hungarian Plain since the Early Neolithic period (circa 6000–5500 cal BC; Craig et al. 2005).

Most studies of animal exploitation strategies focus on faunal remains, but evidence for the use of dairy products also can be found in residues preserved in and on ceramics (Hoekman-Sites 2011; Hoekman-Sites et al. 2006). When combined with the results of faunal analyses (see Chapter 14, this volume), an expanded picture of animal exploitation in the Körös region during the Early Copper Age can be presented.

Residue Analysis on Ceramics from Vésztő-Bikeri and Körösladány-Bikeri

A total of 78 ceramic samples from Vésztő-Bikeri and Körösladány-Bikeri were analyzed for animal fat residue using the method outlined by Copley et al. (2003), with some small alterations. Each ceramic sample was ground into powder using a mortar and pestle. After grinding, residues were extracted in dichloromethane using a sonicator. Once the solid ceramic waste was removed, the solvent containing the residues was concentrated through evaporation. Each sample was analyzed using gas chromatography-mass spectrometry (GC-MS).

The presence of animal fat is determined by the presence of two key lipids. These lipids are $C_{16:0}$ and $C_{18:0}$. Lipids found in residues originate as tri-acyl-glycerols (TAGs), which degrade in most conditions into individual lipids. These individual lipids can degrade further into long-chain hydrocarbons found in the residue samples. Degraded lipids indicate that the studied ceramic vessels once contained dairy products or animal fat residues.

Forty ceramic samples were examined from Vésztő-Bikeri (Table 10.5), and 11 tested positive for animal fat (27.5 percent). From Körösladány-Bikeri, 38 samples were investigated (Table 10.6), and 19 tested positive for animal fat (50 percent).

Ceramic samples came from different locations on the vessels. No rims were examined; only body and base sherds were tested. In the Vésztő-Bikeri sample, among ceramics with animal fat, body sherds and bases equally are represented by 45.5 percent; one sampling location is unknown. Compared to all 78 samples from both sites, many more of the bases from Vésztő-Bikeri tested positive for animal fat. In the combined samples from Vésztő-Bikeri and Körösladány-Bikeri, only 27.5 percent of all samples with positive tests were bases. These results from Vésztő-Bikeri suggest that residues can concentrate in the bottom portion of ceramic vessels as well as along the body. In an experimental study, Charters et al. (1993) boiled plant materials and found that most residues accumulated at the top of the waterlines, closer to the top of the vessels, rather than in their bases. However, if foods cooked in the Vésztő-Bikeri vessels were not boiled, or if the vessels were used only for eating, drinking, or storage, then residues accumulated primarily in the bottom of the vessels.

Of 11 samples containing animal fat from Vésztő-Bikeri, four (36.4 percent) were storage vessels, three (27.3 percent) were serving vessels, and four (36.4 percent) were vessels of unknown function. In the total sample of 40 ceramics from Vésztő-Bikeri, 10 (25 percent) were storage vessels, and 40 percent of them tested positive. More serving vessels (n = 24, or 60 percent) were tested, but only 12.5 percent contained animal fat. This result is not surprising, since vessels used to store foodstuffs contained food for extended periods, which would give residues more time to soak into the ceramic fabric.

Unlike the Vésztő-Bikeri samples, eight body sherds from Körösladány-Bikeri were charred and had visible residues. The function of only one out of the eight vessels with visible residues could be determined; it was a serving vessel. Six of the eight sherds with visible residues (75 percent) tested positive for animal fat. Thirteen of the other 30 samples (43.3 percent) also contained animal fat residues. Of those, one (7.7 percent) was a rim sherd (the only rim tested), six (46.2 percent) were body sherds, and six (46.2 percent) were bases. Animal fat was identified on six of 15 body sherds (40 percent) and six of 14 bases in the sample (42.9 percent). Animal fat residues were also found in vessel bases more frequently than in body sherds at Körösladány-Bikeri. The frequency of nonvisible animal fat residues is significantly higher at Körösladány-Bikeri (43.3 percent) than at Vésztő-Bikeri (27.5 percent).

Of the 13 samples without visible residues containing animal fat from Körösladány-Bikeri, the vessel function of five (38.5 percent) could not be determined, one (7.7 percent) was a storage vessel, and seven (53.8 percent) were serving vessels. The small sample from Körösladány-Bikeri prevents us from drawing conclusions regarding the relations between residues and vessel functions. Out of the three tested ceramic sieves (all from Körösladány-Bikeri)—commonly interpreted as dairy processing tools used to separate curds and whey when making cheese (see Chapter 9, this volume)—two did not contain any animal fat residues. Thus it seems unlikely that ceramic sieves were used exclusively for the processing of dairy products. In the 24 samples with animal fat from Vésztő-Bikeri and Körösladány-Bikeri, 63 percent contained ruminant adipose fat, 28 percent contained porcine adipose fat, and only 9 percent had dairy fat residue. These results suggest that while ruminants and pigs were often butchered and consumed, dairy product use was sporadic and was not a significant part of the subsistence system at the Early Copper Age villages of the Körös region (Hoekman-Sites and Giblin 2012).

Table 10.5. Summary of residue analysis results on ceramics from Vésztő-Bikeri

Sample ID	Animal Fat	Context	Vessel Shape	Location on Vessel			
				Rim	Body	Base	Unknown
HD-104	absent	EU 2-412-53	storage jar		x		
HD-105	absent	EU 2-451-11	storage jar		x		
HD-106	absent	EU 3-157-17	flowerpot		x		
HD-107	absent	EU 2-143	small jar		x		
HD-108	absent	EU 3-178-31	cup		x		
HD-109	absent	EU 3-175	pot/jar		x		
HD-110	absent	EU 3-065-11	cup		x		
HD-112	present	EU 3-172-19	large cup		x		
HD-113	absent	EU 3 174-25	jug/jar		x		
HD-114	absent	EU 3-066-3	small pot/large cup				x
HD-115	absent	EU 3-065-70	small jug/jar/pot		x		
HD-116	absent	EU 3-089-1	cup				x
HD-117	absent	EU 3-185-51	storage jar		x		
HD-118	absent	EU 3-189-17	small jar		x		
HD-119	absent	EU 2-167-35	flowerpot				x
HD-121	absent	EU 3-175-98	medium jar				x
HD-122	present	EU 3-173-65	serving bowl		x		
HD-123	absent	EU 3-179-14	storage jar		x		
HD-124	present	EU 3-175	medium pot			x	
HD-125	absent	EU 2-377-8	bowl		x		
HD-126	absent	EU 3-182-46	medium cup		x		
HD-127	absent	EU 3-192-21/3	bowl				x
HD-128	present	EU 3-178-28	flower pot				x
HD-129	absent	EU 3-081-59	jar/jug				x
HD-130	absent	EU 2-143-204	cup		x		
HD-131	absent	EU 2-447	storage jar		x		
HD-132	absent	EU 2-447	jar/pot			x	
HD-133	absent	EU 2-447	pot			x	
HD-134	absent	EU 2-447	bowl/jar			x	
HD-136	absent	EU 2-269	unknown		x		
HD-137	present	EU 2-279	large storage			x	
HD-138	absent	EU 2-279	large			x	
HD-139	present	EU 2-146	large		x		
HD-140	present	EU 2-146	heavy storage/cook			x	
HD-141	present	EU 2-146	storage jar			x	
HD-142	absent	EU 2-214	pedestalled			x	
HD-143	present	EU 2-214	unknown		x		
HD-144	present	EU 2-214	bowl/jar			x	
HD-145	present	EU 2-234	unknown		x		
HD-146	absent	EU 2-234	pot/cup			x	

Note: N = 40. *Table by Hanneke Hoekman-Sites.*

Visible Residue	Decoration	Decoration Type	Vessel Function		
			Storage	Serving	Unknown
no	no		x		
no	yes	dotted incised, lug	x		
no	yes	lug		x	
no	yes	lug, handle		x	
no	yes	lug		x	
no	no			x	
no	yes	lug		x	
no	yes	lug		x	
no	yes	lug scar		x	
no	yes	lug		x	
no	no			x	
no	yes	lug		x	
no	yes	lug	x		
no	yes	lug		x	
no	yes	lug		x	
no	yes	dotted incised, lug		x	
no	yes	lug		x	
no	yes	lug	x		
no	no				x
no	no			x	
no	yes	lug		x	
no	yes	lug		x	
no	yes	dotted incised, lug			x
no	yes	lug		x	
no	yes	lug		x	
no	yes	lug	x		
no	no			x	
no	no				x
no	no			x	
no	yes	lug			x
no	no		x		
no	no		x		
no	yes	lug	x		
no	no		x		
no	no		x		
no	no			x	
no	yes	lug			x
no	no			x	
no	yes	lug			x
no	no			x	

Table 10.6. Summary of residue analysis results on ceramics from Körösladány-Bikeri

Sample	Animal Fat	Context	Vessel Shape	Location on Vessel			
				Rim	Body	Base	Unknown
HD-054	present	EU 7-055, F48	unknown		x		
HD-055	absent	EU 7-055, F48	unknown		x		
HD-056	present	EU 7-055, F48	unknown		x		
HD-057	absent	EU 7-055, F48	unknown		x		
HD-058	present	EU 7-055, F48	unknown		x		
HD-059	present	EU 7-055, F48	unknown		x		
HD-060	present	EU 7-055, F48	unknown		x		
HD-061	present	EU 7-064, F48	bowl		x		
HD-062	absent	EU 7-064, F48	medium jug			x	
HD-063	present	EU 7-064, F48	cup/bowl			x	
HD-064	present	EU 7-064, F48	bowl			x	
HD-065	present	EU 7-055, F48	unknown		x		
HD-067	present	EU 6-022-1, F35	unknown	x			
HD-068	absent	EU 6-022-12, F35	small jar/jug			x	
HD-069	present	EU 6-061, F35	pot			x	
HD-070	absent	EU 6-049-8, F35	unknown		x		
HD-071	absent	EU 6-044-5, F35	unknown		x		
HD-072	present	EU 6-046-3, F35	unknown		x		
HD-073	absent	EU 6-030-10	sieve		x		
HD-074	absent	EU 5-121-13	sieve		x		
HD-075	present	EU 5-120-22, F30	storage		x		
HD-076	present	EU 5-124-2, F30	small jar		x		
HD-077	present	EU 5-104-10, F30	unknown			x	
HD-078	present	EU 5-106-3, F30	small jar		x		
HD-079	present	EU 6-027, F35	cup			x	
HD-080	present	EU 4-103-37, F10	unknown			x	
HD-081	absent	EU 4-103-01, F10	unknown			x	
HD-082	absent	EU 4-103-33, F10	small jar/cup			x	
HD-083	absent	EU 4-103-43, F10	medium pot		x		
HD-084	absent	EU 4-103-35, F10	cup/small jar			x	
HD-085	absent	EU 4-121-9, F28	jar/jug/bowl			x	
HD-086	absent	EU 4-121-8, F28	cup			x	
HD-087	absent	EU 4-138-2, F28	jar				x
HD-088	absent	EU 4-154-13, F28	jar				x
HD-089	absent	EU 6-027-9, F35	unknown				x
HD-090	absent	EU 6-024-4, F35	jar				x
HD-091	absent	EU 6-026-4, F35	unknown			x	
HD-135	present	EU 4-033-19, F5	sieve		x		

Note: N = 38. *Table by Hanneke Hoekman-Sites.*

Visible Residue	Decoration	Decoration Type	Vessel Function		
			Storage	Serving	Unknown
yes	no				x
yes	no				x
yes	no				x
yes	no				x
yes	no				x
yes	no				x
yes	no			x	
no	no			x	
no	yes	lugs			x
no	no			x	
yes	yes	lugs		x	
no	no				x
no	no				x
no	yes	lug		x	
no	yes	lug			x
no	yes	lug			x
no	yes	lug			x
no	yes	shell incision		x	
no	yes	sieve			x
no	yes	sieve			x
no	yes	lug scar	x		
no	yes	lugs		x	
no	no			x	
no	yes	lug			x
no	yes	lug		x	
no	no				x
no	no				x
no	yes	dotted incised		x	
no	no				x
no	no			x	
no	no				x
no	no			x	
no	yes	lug		x	
no	yes	lug		x	
no	no				x
no	yes	lug		x	
no	no				x
no	yes	sieve			x

Conclusions

The results of the mineralogical, petrographic, and residue analyses of Early Copper Age ceramic assemblages from the Vésztő-Bikeri and Körösladány-Bikeri villages provided insights about the production, distribution, and use of ceramics at dispersed agropastoral settlements. Residue analysis indicated that Early Copper Age agropastoralists made limited use of secondary products of domestication, even though there was a decline in hunting and a greater reliance on mixed herds of livestock (see Chapter 14, this volume).

Despite the geological homogeneity of the Körös region, petrographic and chemical studies were able to identify the exchange of ceramics among Tiszapolgár settlements in the region, indicating interaction between communities. That said, the overall lack of significant numbers of confirmed ceramics imported into the Körös region from elsewhere in the Carpathian Basin indicates that interregional interaction decreased after the abandonment of the Late Neolithic nucleated settlements that had played focal roles in trade (Gyucha et al. 2009; Parkinson et al. 2010b). This pattern also is apparent in the results of the chipped stone artifact analysis (see Chapter 12, this volume). Our mineralogical and petrographic analyses of ceramic samples from Early Copper Age settlements in and beyond the Körös region suggest that while there was continuous, intensive interaction among neighboring communities within the Körös River basin, long-distance exchanges were limited (Gyucha 2015; Gyucha and Parkinson 2013; Hoekman-Sites et al. 2006; Parkinson 2006b).

Chapter 11

Bone, Antler, and Tusk Artifacts

Zsuzsanna Tóth, Alice M. Choyke, and Attila Gyucha

This study is the first systematic examination of worked osseous materials from Early Copper Age Tiszapolgár settlement contexts. Field methods during most of the earlier—nineteenth- and twentieth-century—excavations at Tiszapolgár sites did not allow the recovery of all the worked osseous objects, and even the collected bone, antler, tooth, and tusk tools have never been studied in detail. Some tool types or objects from burials or special contexts were reported from Early Copper Age sites on the Great Hungarian Plain (Bognár-Kutzián 1963, 1972; Goldman and Szénászky 2012), but they are exceptions rather than the rule and do not represent the full range of bone and antler artifacts from those sites. Even in western Hungary, only one complete Middle Copper Age assemblage has been studied from a Boleráz context (Choyke 2014). Prior to the present study, from the Bikeri sites, only the antler arrowheads excavated at Vésztő-Bikeri have been published and discussed (Choyke and Daróczi-Szabó 2010; Gyucha et al. 2004; Parkinson et al. 2004b).

Typology of Bone, Antler, and Tusk Artifacts from Vésztő-Bikeri

The relative abundance of the different types of 256 worked bone, antler, and tusk tools from the Vésztő-Bikeri site is shown by number and weight in Figures 11.1–11.2 (see also Tables 11.1–11.2). The artifact typology used here is based on the system developed by Schibler (1981) during studies of worked osseous materials from Late Neolithic Swiss lake-dwelling sites.

Bone Awls

Bipartitioned metapodial awls from small ruminants are common tools in prehistoric artifact assemblages from the end of the Paleolithic. In the Copper Age, other awl types became increasingly common. At Vésztő-Bikeri, only one bipartitioned, small ruminant metapodial awl was recovered (Schibler Type 1/1; Murray 1979:28). The distal epiphysis is preserved on this object. One example of a special subtype, a quartered roe deer (*Capreolus capreolus*) metatarsal awl, also is part of the assemblage (Schibler Type 1/2a; Figure 11.3A; for a discussion of this type, see Choyke and Tóth 2013). Although the proximal epiphysis had broken off, the fracture plane was reworked, and the awl seems to have been used for a long time.

Several awl tips, probably from Type 1/1 or 1/2 awls, also were recovered at Vésztő-Bikeri. On other awl fragments, the grooves are no longer visible, and these fragments are assigned to pointed tool typological groups 1/7 (small point or awl) or 1/? (unidentifiable). Additional small awls found at Vésztő-Bikeri include a Schibler Type 1/3 artifact made from a caprine (sheep or goat) tibia splinter (Figure 11.3B). This type is more common in bone tool assemblages from later time periods.

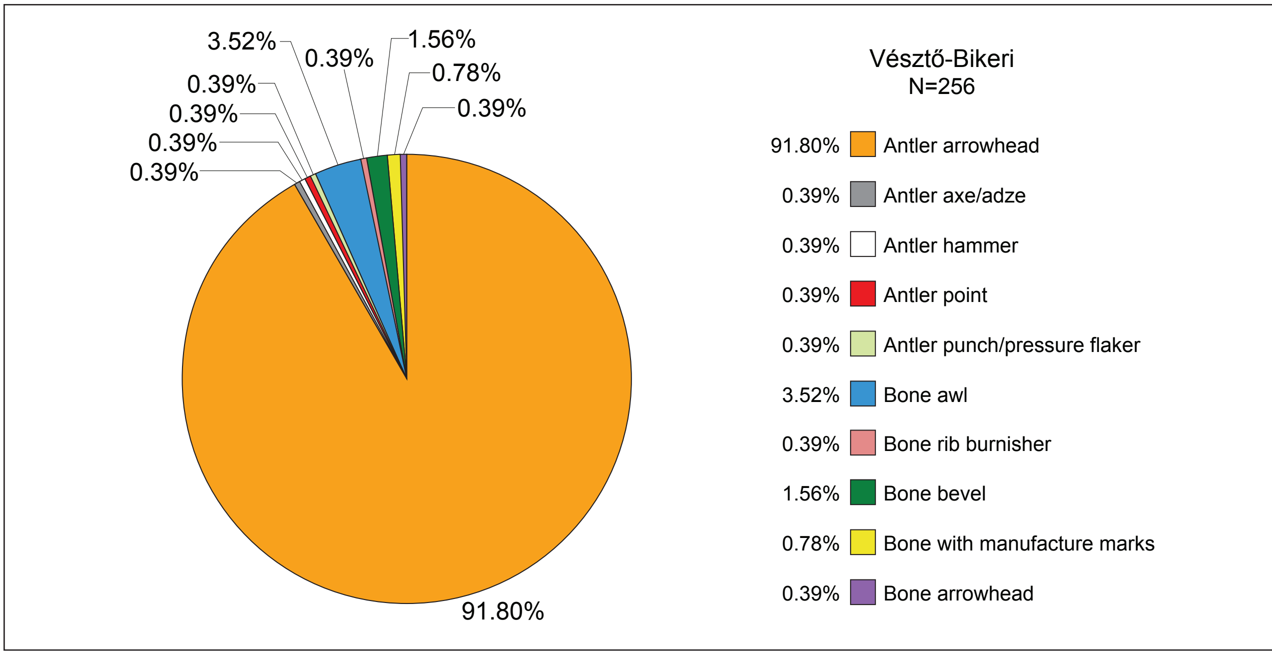


Figure 11.1. Relative abundance (by number) of worked antler and bone tools from Vésztő-Bikeri. *Figure by Zsuzsanna Tóth.*

Table 11.1. Numbers of worked antler and bone tools from Vésztő-Bikeri and Körösladány-Bikeri

Raw Material	Type	Vésztő-Bikeri	Körösladány-Bikeri	Total Number
		Number		
Bone	awl 1/1	1	0	1
	awl 1/2	0	2	2
	awl 1/2a	1	1	2
	awl 1/1 or 1/2	1	0	1
	awl 1/5	1	1	2
	awl 1/7	3	7	10
	awl 1/?	2	2	4
	rib burnisher	1	3	4
	scraper	0	3	3
	spoon	0	1	1
	spatula	0	1	1
	bevel 4/8	4	1	5
	bone with manufacture marks	2	0	2
	arrowhead	1	0	1
Antler	arrowhead	235	0	235
	axe/adze	1	0	1
	pick	0	1	1
	hammer	1	2	3
	point	1	0	1
	punch/pressure flaker	1	0	1
	ornamented rod	0	1	1
Total Number		256	26	282

Table by Zsuzsanna Tóth.

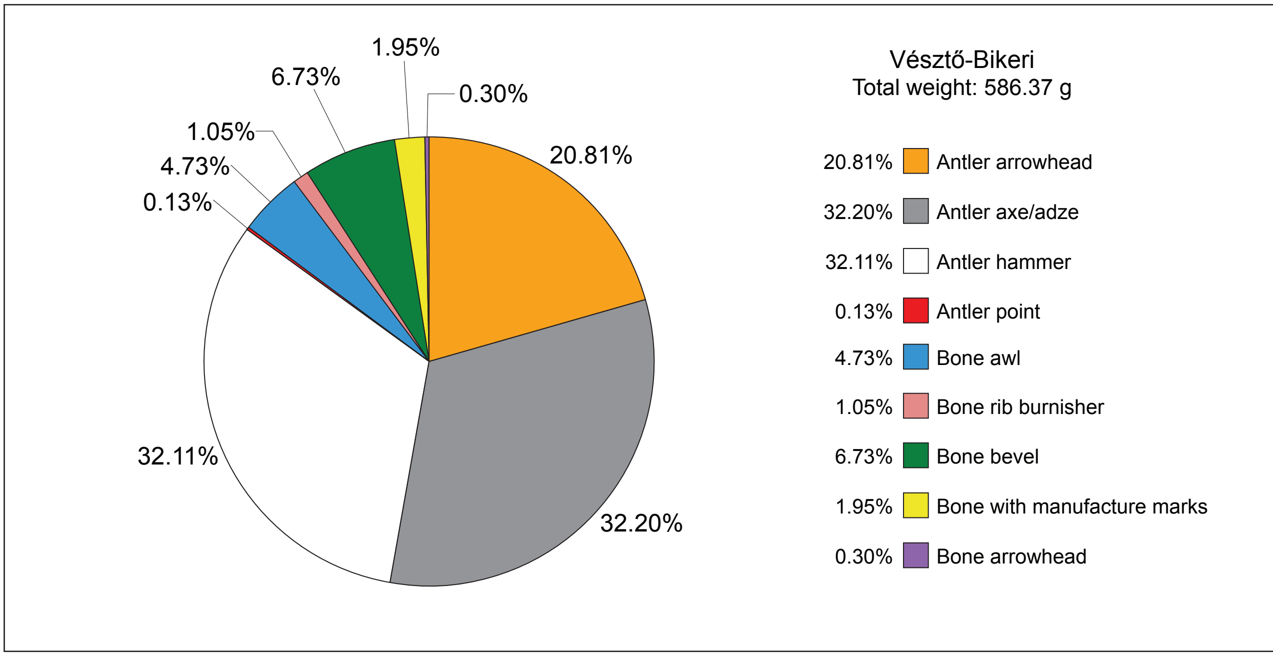


Figure 11.2. Relative abundance (by weight) of worked antler and bone tools from Vésztő-Bikeri. *Figure by Zsuzsanna Tóth.*

Table 11.2. Weights of worked antler and bone tools from Vésztő-Bikeri and Körösladány-Bikeri

Raw Material	Type	Vésztő-Bikeri	Körösladány-Bikeri	Total Weight (g)
		Weight (g)		
Bone	awl 1/1	1.55	0	1.55
	awl 1/2	0	10.22	10.22
	awl 1/2a	4.53	6	10.53
	awl 1/1 or 1/2	1.4	0	1.4
	awl 1/5	4.53	4.12	8.65
	awl 1/7	11.77	17.39	29.16
	awl 1/?	1.22	2.43	3.65
	rib burnisher	5.55	147.35	152.9
	scraper	0	28.8	28.8
	spoon	0	8.47	8.47
	spatula	0	1.04	1.04
	bevel 4/8	35.4	11.47	46.87
	bone with manufacture marks	10.24	0	10.24
	arrowhead	1.56	0	1.56
Antler	arrowhead	110.71	0	110.71
	axe/adze	169.45	0	169.45
	pick	0	135	135
	hammer	169	537.65	706.65
	point	0.71	0	0.71
	punch/pressure flaker	60.06	0	60.06
	ornamented rod	0	7.16	7.16
Total Weight (g)		587.68	917.1	1,504.78

Table by Zsuzsanna Tóth.

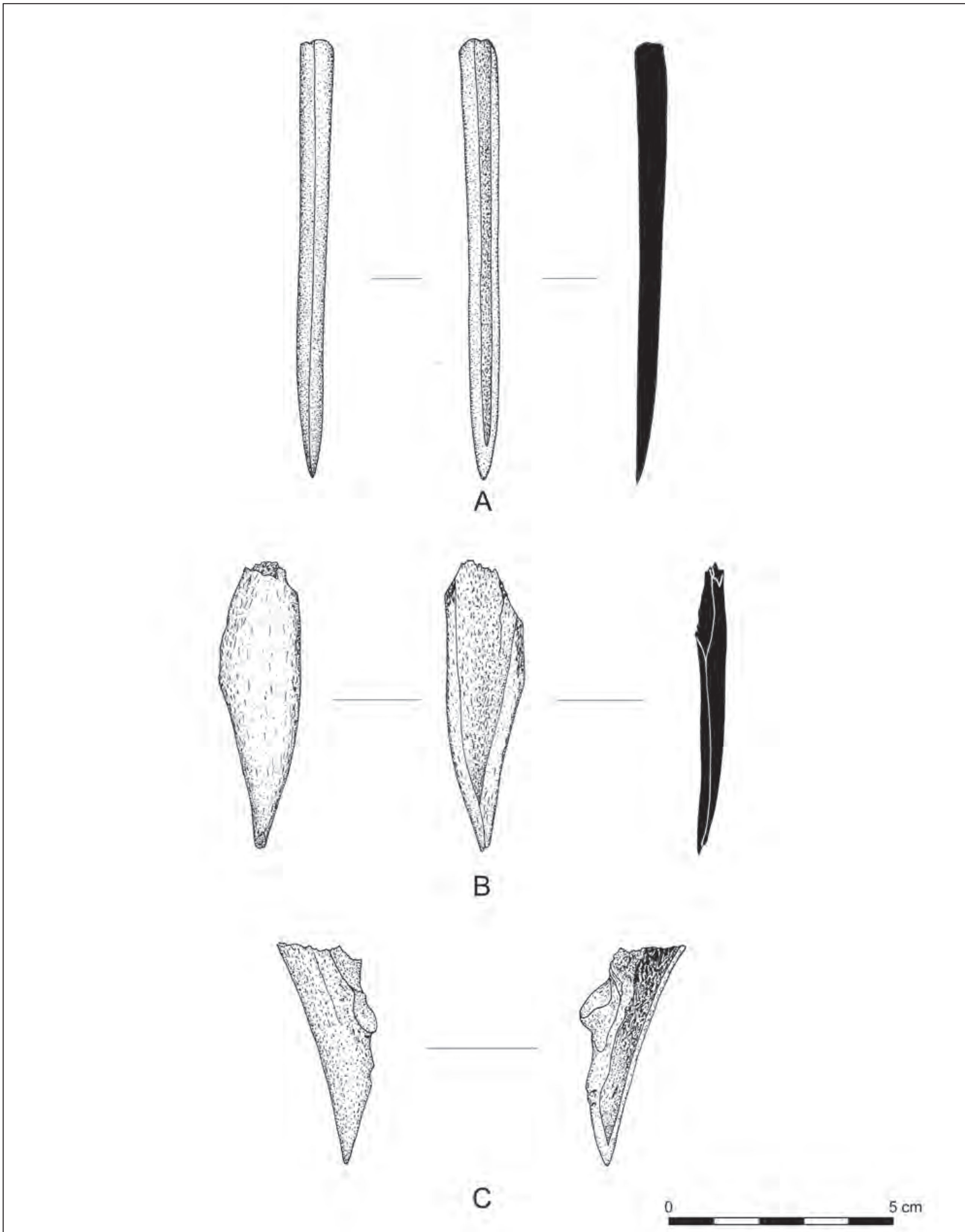


Figure 11.3. Awls from Vésztő-Bikeri. A: Quartered roe deer awl (Schibler Type 1/2a; V20SF515); B: Awl made on caprine tibia shaft splinter (Schibler Type 1/3; V20SF251); C: Awl or point made on a domestic pig ulna fragment (Schibler Type 1/5; V20SF528). *Figure by Dorottya Kékegyi.*

Two awls or points from Vésztő-Bikeri are worked on domestic pig (*Sus domesticus*) bones or tusks, which is fairly unusual in prehistoric bone tool assemblages in the Carpathian Basin. A pig ulna was used to make an awl or point (Schibler Type 1/5; Figure 11.3C). The tool may have been made on a short segment of a proximal pig ulna or it was resharpened until it became quite short. The other tool was made from the lower canine (tusk) of a male pig (Figure 11.4A). After the whole surface of the tusk was scraped, it was sharpened to a point but not split. Use-wear polish, rounding of the edges, and an impact fracture can be seen on the tip.

Various methods were used to manufacture the awls. Debitage by groove and splinter produced the preforms used to make the small ruminant metapodial awls (Schibler Types 1/1, 1/2, and 1/2a), although scraping or abrasion was used for final shaping. Some awls were made on complete long bone shafts, not split shaft fragments (Schibler Types 1/3 and 1/5).

Bone Arrowhead

There is a single arrowhead made from bone in the Vésztő-Bikeri assemblage (Schibler Type 3/2; Figure 11.4B). It is an unfinished, stemmed triangular object made from a large ungulate long bone shaft fragment. It was found among the concentration of antler arrowheads on the floor of the Feature 4/14 longhouse (see Chapter 7, this volume). Similar bone arrowheads were recovered from the Late Copper Age Boleráz culture site of Győr-Szabadrét-domb in northwestern Hungary (Choyke 2014:Figure 13c), the Copper Age Cortaillod period Swiss lake-dwelling Twann site (Schibler 1981:Figures 45:4 and 47:15), and Italian Bronze Age Terramare sites (Provenzano 2001:Figure 147:4–5).

Burnishers

Rib burnishers are represented by a single piece at Vésztő-Bikeri, although they are more common at other Early Copper Age sites (see below), including Körösladány-Bikeri. The piece was manufactured from a split cattle (*Bos* sp.) rib, with chipping exhibited along the beveled edge and some polish and rounding from use.

Beveled Tools

There are four bevel-ended bone tools in the Vésztő-Bikeri assemblage. Two were made on caprine tibia shafts (Figure 11.4C), one was made on a pig tibia (Figure 11.5A), and one on an equid metatarsal that may be intrusive and thus may not date to the Early Copper Age (Figure 11.5B). Beveled tools made from caprine tibia are found at prehistoric sites across Europe and became more common during the Copper and Bronze Ages (Choyke and Bartosiewicz 1999–2000:56–57; Gál 2011:Figure 5; Korošec and Korošec 1969:Plate 92). Usually, the bevel-ended tools were made on whole bone shafts with or without the epiphysis; three tools from Vésztő-Bikeri did not retain the epiphysis. The bevel was formed by abrading (on a rough-grained stone) a long tongue-shaped bone splinter. All four bevel-ended tools displayed flaking from use on their working ends and some polish and rounding on their surfaces.

Manufacturing Marks

Two bone fragments from the Vésztő-Bikeri assemblage exhibit manufacturing marks. One is a dog metatarsal with four almost parallel sawing marks near the epiphysis. Many prehistoric dog (and also hare) metapodial bones are made into pendants. They often are ornamented with incised lines (Choyke et al. 2004:187; Schibler 1981:Abbildung 29, Tafel 39:13–16). The dog metatarsal may be an unfinished pendant that was broken during manufacture. The other fragment is a large, calcined, ungulate long bone splinter that was scraped. It could not be assigned to a particular tool class.

Heavy-Duty Antler Tools

There are few heavy-duty red deer (*Cervus elaphus*) antler tools from Vésztő-Bikeri. One piece can be identified as a hammer (Figure 11.6A), while another piece might have been an axe or adze (Figure 11.6B). Hammers were often made from the basal part of the red deer antler beam, including the medallion (rose) and pedicle from hunted animals. However, this antler hammer from Vésztő-Bikeri was made by chopping off the tines from a shed antler. The hafting hole was drilled right above the medallion. Use-wear is visible as surface crushing on the tool.

The antler axe/adze was made from a proximal antler beam section that had been cut on both ends. A hafting hole was cut through the center, and the rough surface of the antler was smoothed by abrasion. On the flat end, the spongy core of the antler was carved out to form a socket. The other end was beveled. Heavy use damage can be seen on the beveled end, which was broken. The surface is rounded and marked with striations.

Worked Antler Tines

There is a cut-down antler tine from Vésztő-Bikeri that was probably used as a punch or pressure flaking tool (Figure 11.5C). The tine was chopped off from the beam, and almost the entire surface was scraped smooth. Traces of manufacture and use can be seen on the surface as striations caused by contact with flint implements, polish, and rounding. The tip is worn through to the spongy antler core. A burned antler tine tip in the assemblage may have been used as a point or arrowhead, but its exact type and function cannot not be determined.

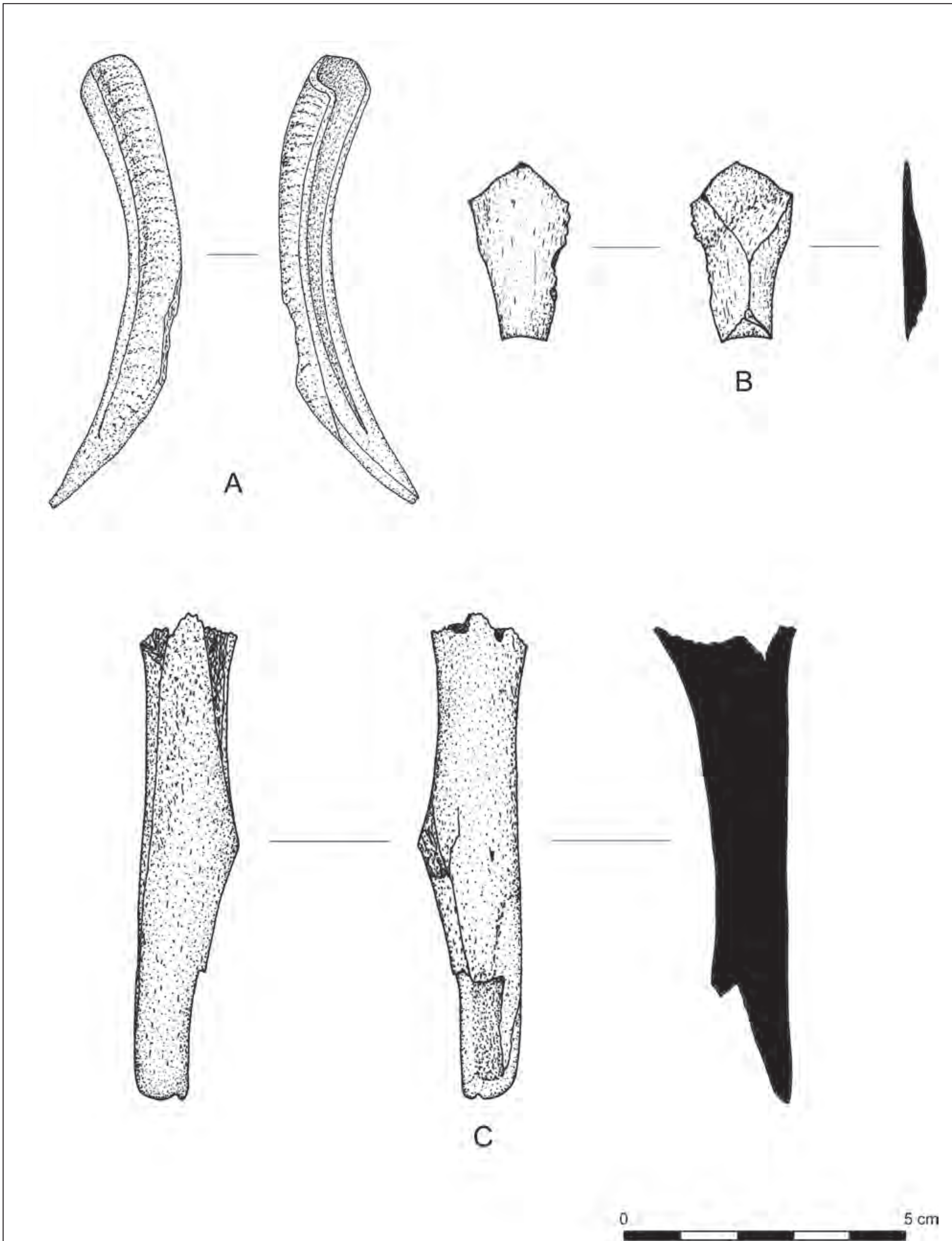


Figure 11.4. Worked tusk and bone artifacts from Vésztő-Bikeri. A: Point or awl made by sharpening a domestic pig canine (tusk; V20SF530); B: Unfinished bone arrowhead (V20SF259); C: Bevel on caprine tibia shaft (V20SF551). *Figure by Dorottya Kékegyi.*

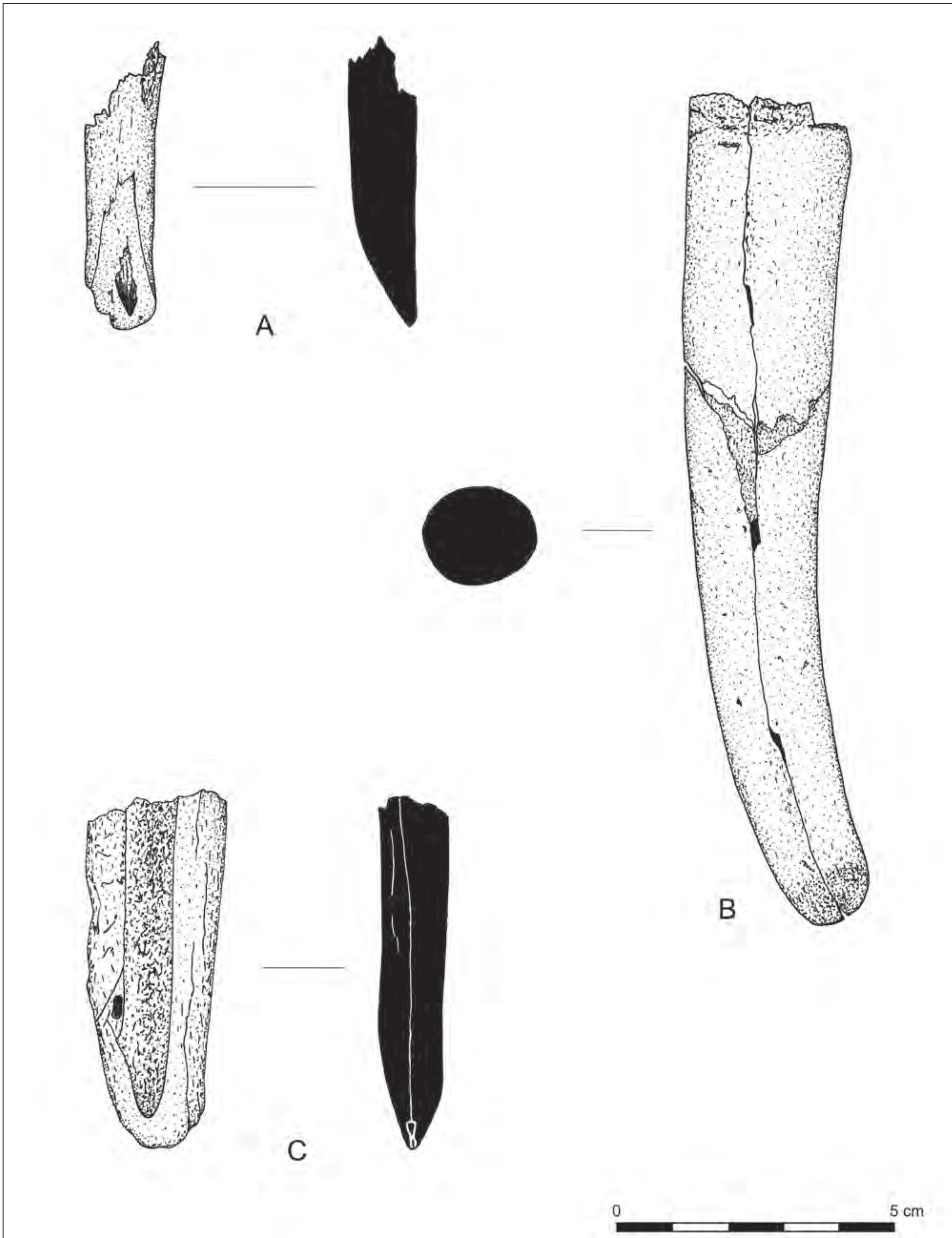


Figure 11.5. Bone and antler tools from Vésztő-Bikeri. A: Bevel-end tool made on a pig tibia (V20SF556); B: Red deer antler tine used as punch or pressure flaker (V20SF262); C: Bevel-end tool made on an equid metatarsal shaft (V20SF558). *Figure by Dorottya Kékegyi.*

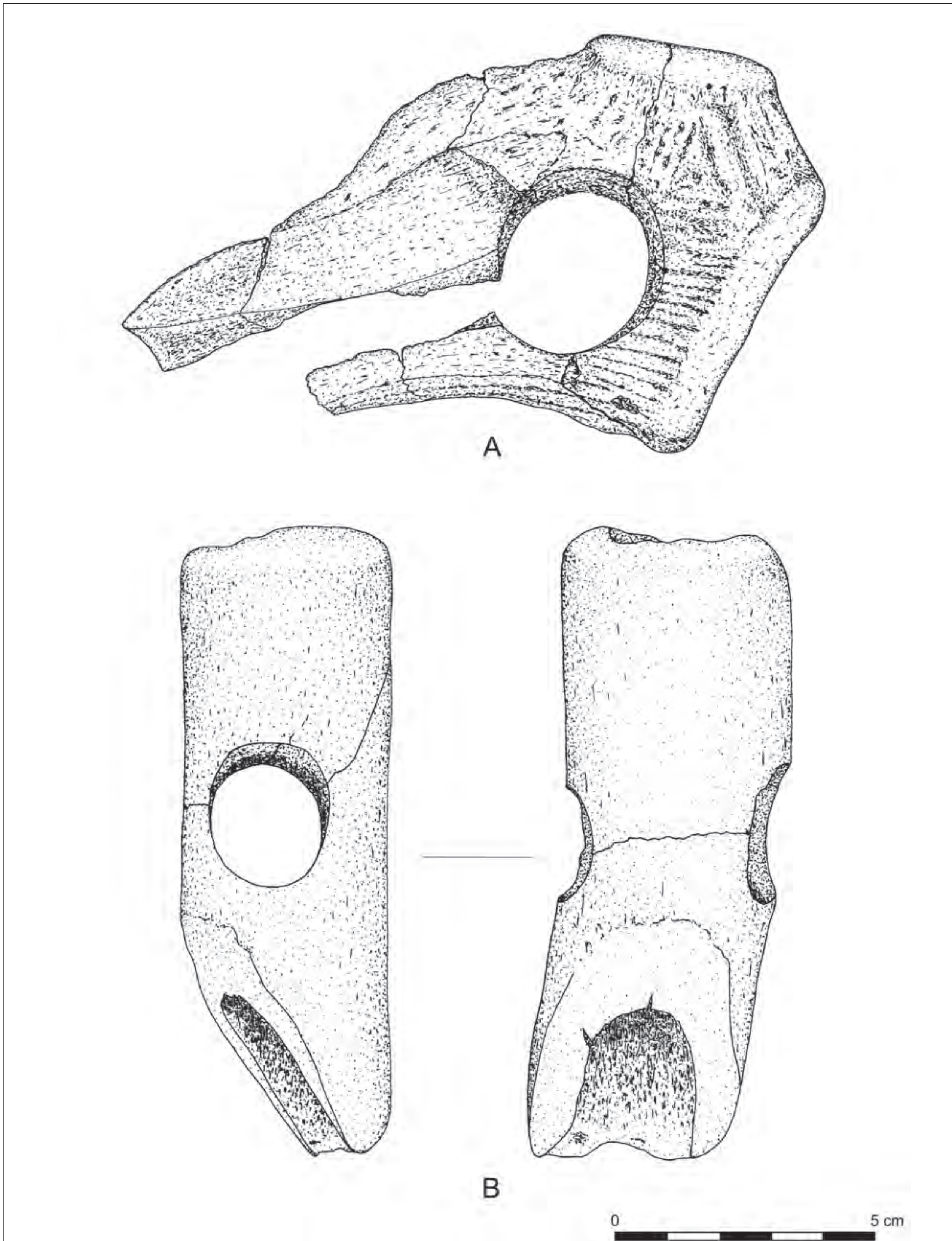


Figure 11.6. Heavy-duty red deer antler tools from Vésztő-Bikeri. A: Hammer (V20SF084); B: Axe or adze (V20SF559). *Figure by Dorottya Kékegyi.*

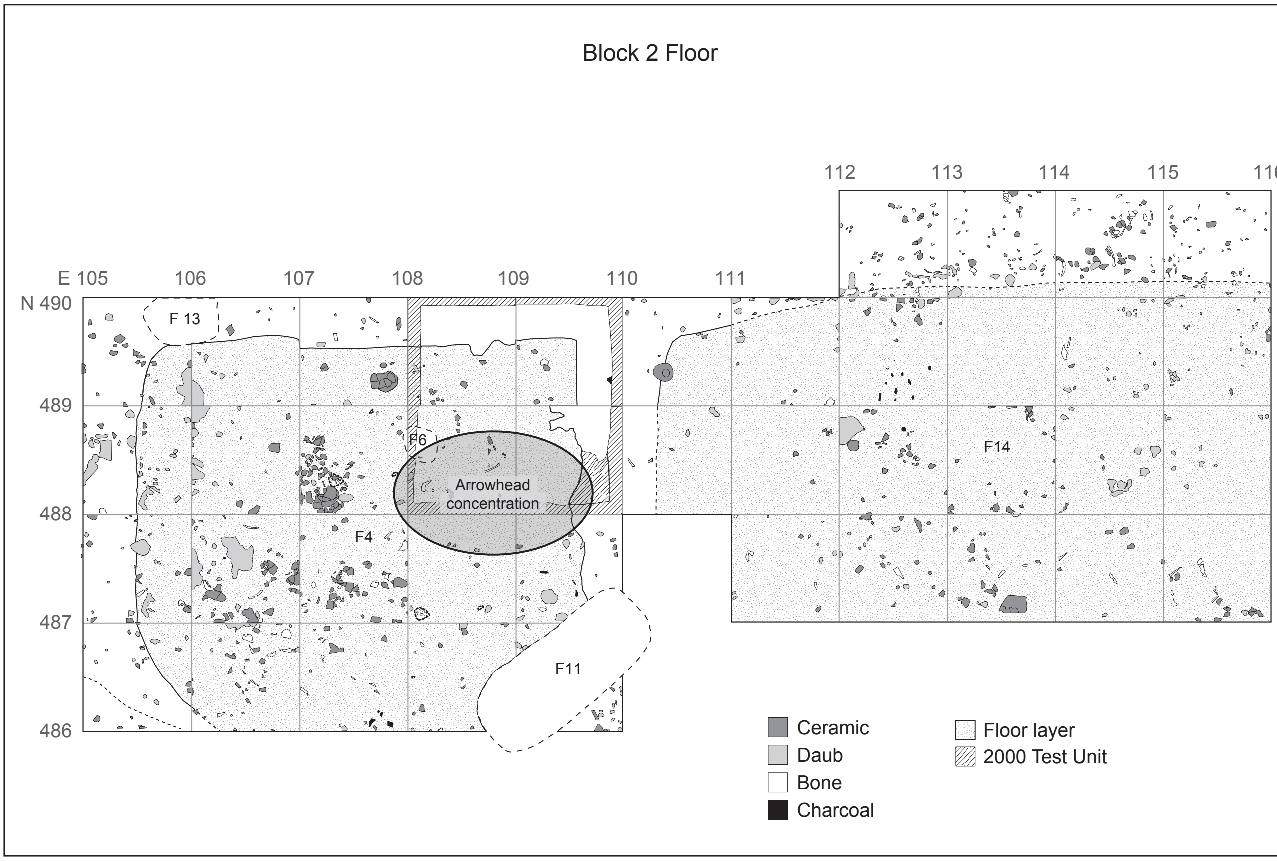


Figure 11.7. Location of the arrowhead concentration on floor and within daub layer above floor in Feature 4/14 longhouse at Vésztő-Bikeri. *Figure by Richard W. Yerkes, Daniel Sosna, and Jill Seagard.*

Antler Arrowheads

A total of 235 antler arrowheads were recovered at Vésztő-Bikeri. Almost all of this sub-assemblage, 233 pieces, was found in a roughly 1.5 x 1.0 m area, on the floor of the Feature 4/14 longhouse and in the burned daub layer that covered the floor (Figure 11.7; see also Chapter 7, this volume). Two specimens came to light in other parts of the settlement: one in the cultural layer superimposing the Feature 5 longhouse in Block 3 (V20SF083) and another in a pit (Feature 98; V20SF516) that was dug into the cultural layer covering the Feature 15 longhouse in Block 9. These two arrowheads may have been moved from their original location in Feature 4/14 when the abandoned longhouses in the center of the Vésztő-Bikeri site were mounded over by soils rich in cultural material (see Chapter 8, this volume).

The antler arrowheads can be classified into three basic types (A, B, and C), with further variations (Figures 11.8–11.10). Typology and a functional interpretation were presented by Choyke and Daróczi-Szabó (2010:241), drawing on Pape's (1982:135–72) descriptions based on Bronze and Iron Age arrowhead types. Almost all the arrowheads from Vésztő-Bikeri were made from red deer antler. The sole exception is the bone arrowhead described above (Figure 11.4B).

Type A arrowheads are stemmed triangular points (Figures 11.8–11.10). Arrowheads with narrow triangular blades are classified as Type A1, while ones with wider triangular blades belong to Type A2. In most cases, the narrower A1 variation has a simpler form. They were shaped by cutting and scraping with an edged, chipped stone tool. Sawing traces also can be seen by the stem. A ridge sometimes can be observed along the midline on Type A arrowheads. The lone bone arrowhead belongs to the A2 variation. Its shape was only roughed out, and scraping marks from a chipped stone tool were identified on the surface.

Type B arrowheads are bayleaf-shaped, with a drilled hole running through the length of the stem (Figures 11.8–11.10). A narrow variant, Type B1, and a wider form, Type B2, were separated. Sometimes a ridge can be seen along the midline as in triangular Type A. Type B arrowheads seem to have been hafted by inserting the arrow shaft into the base of the projectile point.

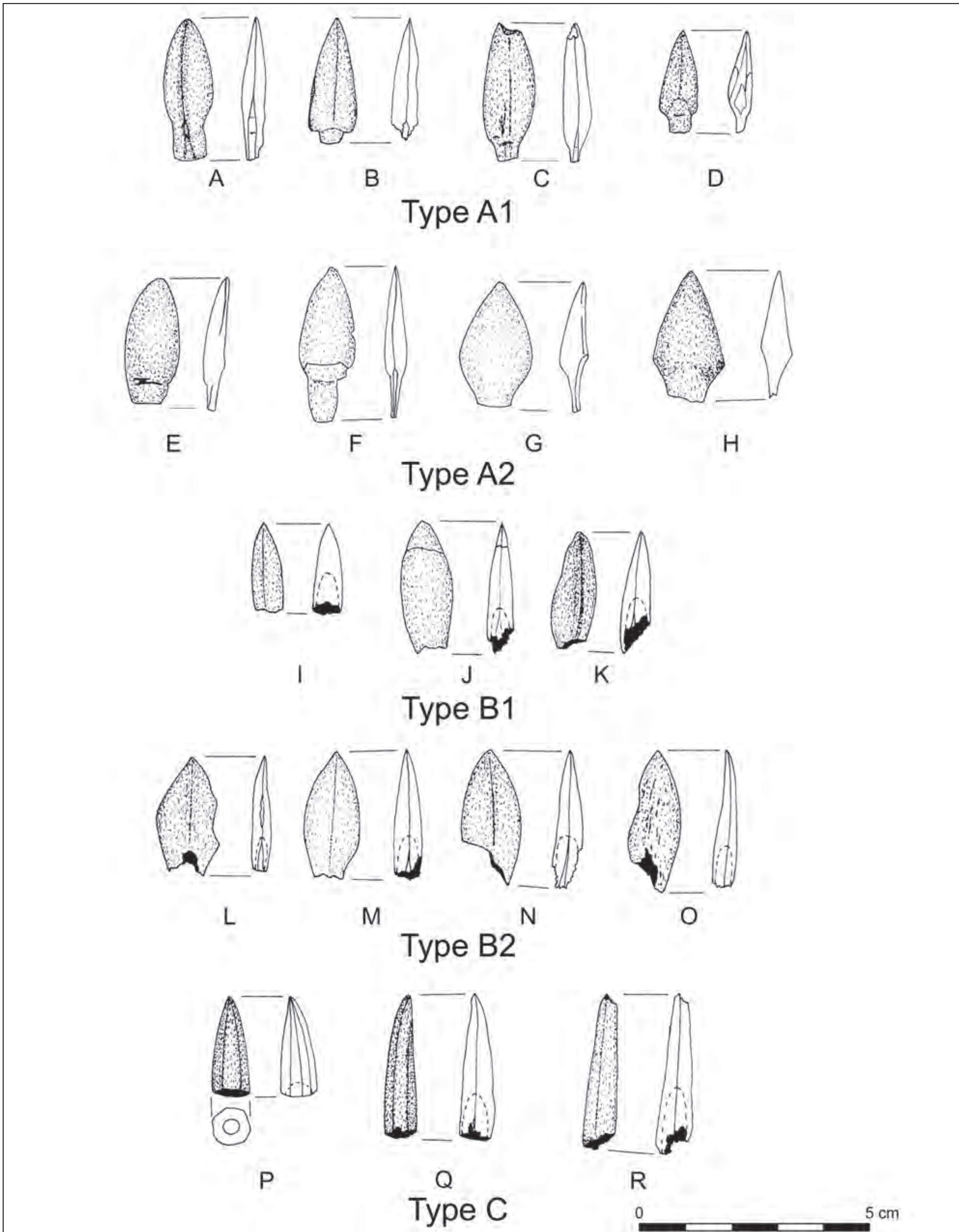


Figure 11.8. Arrowhead types from Vésztő-Bikeri. A: V20SF083; B: V20SF079; C: V20SF060; D: V20SF060; E: V20SF060; F: V20SF001; G: V20SF066; H: V20SF066; I: V20SF102; J: V20SF069; K: V20SF056; L: V20SF060; M: V20SF079; N: V20SF102; O: V20SF060; P: V20SF050; Q: V20SF057; R: V20SF081. *Figure by Dorottya Kékegyi.*

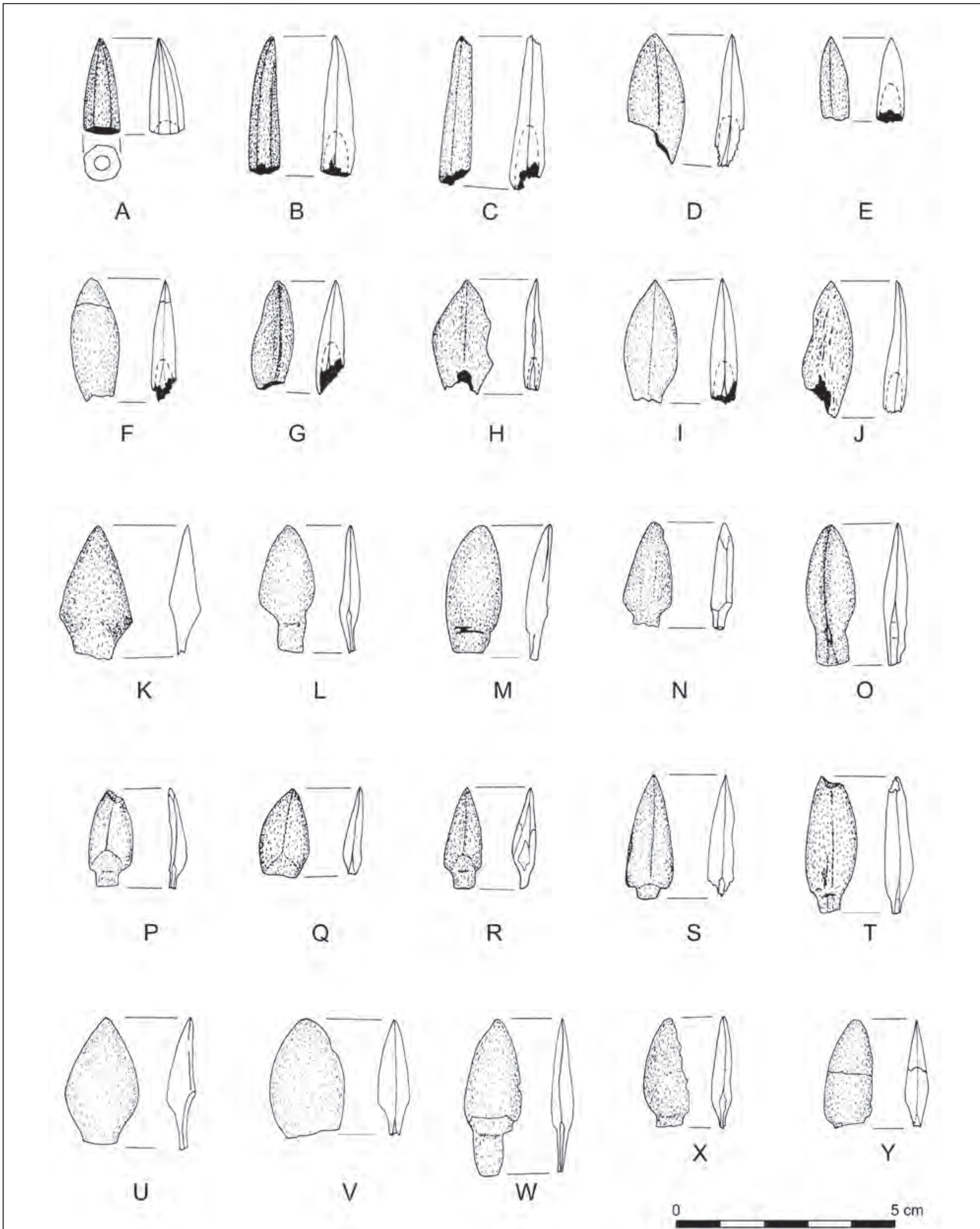


Figure 11.9. Arrowheads from Vésztő-Bikeri. A: V20SF050; B: V20SF057; C: V20SF081; D: V20SF102; E: V20SF102; F: V20SF069; G: V20SF056; H: V20SF060; I: V20SF079; J: V20SF060; K: V20SF098; L: V20SF065; M: V20SF060; N: V20SF059; O: V20SF083; P: V20SF068; Q: V20SF060; R: V20SF060; S: V20SF079; T: V20SF060; U: V20SF066; V: V20SF066; W: V20SF001; X: V20SF005; Y: V20SF002. *Figure by Dorottya Kékegyi.*

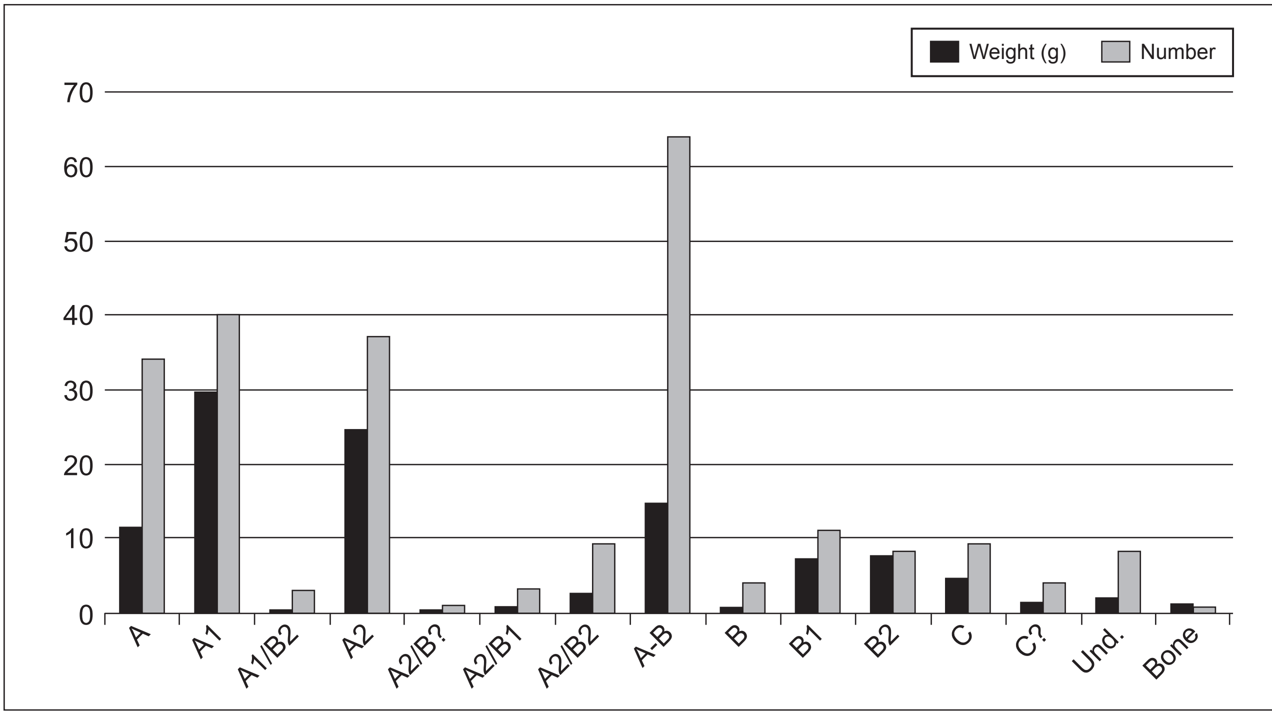


Figure 11.10. Number and weight of different types of arrowheads from Vésztő-Bikeri. *Figure by Zsuzsanna Tóth.*

Type C arrowheads have prismatic shapes with a hole drilled for hafting through the length of the stem (Figures 11.8–11.10). The facets of the prism are clearly visible, usually creating blades with hexagonal cross-sections. There are only a few examples of this arrowhead type from Vésztő-Bikeri. A similar, approximately 2 cm–long worked bone artifact—triangular, with a hole for hafting—is known from Early Copper Age contexts in the Romanian Banat (Radu 2002:75, Plate 14:14). The Type C group is identical to Pape's Type E (1982:145–48, Figure 5:8–10, Figure 13). The geographical distribution of Type C–form arrowheads during the European Bronze and Iron Ages includes Spain, France, Switzerland, Italy, Germany, and Poland, but heretofore not Hungary.

There are nearly 30 complete arrowheads from Vésztő-Bikeri. Type A arrowheads measure between 23.5 and 28.5 mm in length and from 10.5 to 16.5 mm in width, while Type B artifacts range between 22 and 31.5 mm in length and from 9 to 16.5 mm in width. Type C specimens measure between 30 and 35 mm in length and between 4.5 and 8 mm in width. The thickness of Type A and B arrowheads ranges between 3 and 6 mm. The complete artifacts weigh between 0.8 and 1.7 g (Figure 11.10). These are the dimensions of heavily burned and calcined antler implements; originally they likely would have been slightly larger and heavier.

It is not possible to reconstruct the entire manufacturing process of the arrowheads, although in most cases of Type A and Type B, they were produced from antler flakes, possibly from antler tines. The scraped antler spongy core is often visible on one surface, and the compact outer surface of the antler can be seen on the opposite face. Type C arrowheads often were made from antler tine tips, and the spongy antler core was drilled through from the base. At least two methods were used to remove excess antler raw material while shaping the object. One method was to flake off the excess material, while in the other approach, antler fragments were sawn into segments. Final shaping was usually carried out by scraping. Abrasion sometimes may have been employed as well. The stems of Type A arrowheads often were sawed, and the sawing marks are still visible, suggesting that this surface was protected from contact wear with other materials, although generally speaking, arrowheads rarely exhibit use-wear connected to long use (Choyke and Daróczi-Szabó 2010:241). Other manufacturing marks are not identifiable on the specimens because of the heavy calcination from secondary burning.

Typology of Bone and Antler Artifacts from Körösladány-Bikeri

A total of 26 tools manufactured from antler and bone were found in Early Copper Age contexts at Körösladány-Bikeri. The relative abundance of the various types of worked bone and antler tools from the site is shown in Figures 11.11–11.12, and absolute numbers are summarized in Tables 11.1–11.2. Most of the tools are made from bone (n = 22), including 13 awls, three rib burnishers, three scrapers, a bevel, a spatula, and a spoon. Three of the four antler artifacts are heavy-duty tools: two hammers and a pick. A decorated antler rod also was recovered. Arrowheads like those found at Vésztő-Bikeri are not present in the Körösladány-Bikeri assemblage.

Bone Awls

Several different types of bone awls were made and used at Körösladány-Bikeri. There are two bipartitioned, small ungulate metapodial awls with the distal epiphysis intact (Schibler Type 1/2) and a quartered, long, slender roe deer metapodial awl (Schibler Type 1/2a; Figure 11.13A; Choyke and Tóth 2013). There is one example of a small Schibler Type 1/5 specimen made from the ulna of a roe deer and barely modified, as well as one unidentified (Type 1/?) awl. These artifacts seem to have been manufactured from bone fragments in an ad hoc fashion. The most common awls in the Körösladány-Bikeri assemblage are seven Schibler Type 1/7 forms made from shafts of small ungulates (probably caprines). Our data indicate that traditional multistage awl production using carefully selected materials became less common during the Early Copper Age. Typically, more awls were made from bones selected from the butchering and cooking refuse; they were easily and quickly sharpened and less often curated (Choyke 1997:66).

Other Bone Tools

Three rib burnishers and three rib or long bone shaft scrapers were recovered during the excavations at Körösladány-Bikeri. The distinction between a scraper and a burnisher is based on the location of the worked area, either the end (scraper) or edge (burnisher; see Figure 11.13C). These tools also were manufactured in an ad hoc fashion. Single examples of other bone tool types occur in the assemblage as well. These include a bevel-edged tool made from a long, tongue-shaped splinter from a caprine tibia shaft. Bevel-edged tools are relatively common at Copper Age sites (Beldiman et al. 2012:Plate112; Choyke 2014:Table 3; Gál 2012:341–43, Tables 1–2).

A spatulate tool was made by abrading and smoothing a small ungulate long bone shaft fragment. A fragment of a very elaborate, decorated spoon made from the long bone shaft of a large ungulate stands out in the bone tool

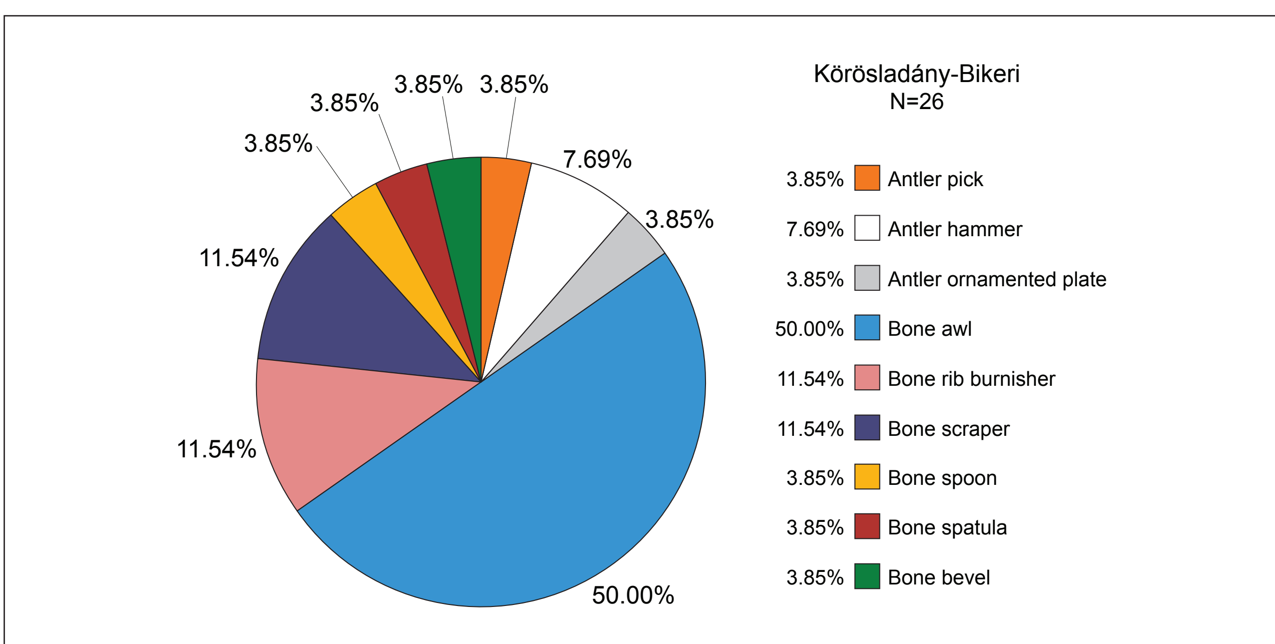


Figure 11.11. Relative abundance (by number) of worked antler and bone tools from Körösladány-Bikeri. *Figure by Zsuzsanna Tóth.*

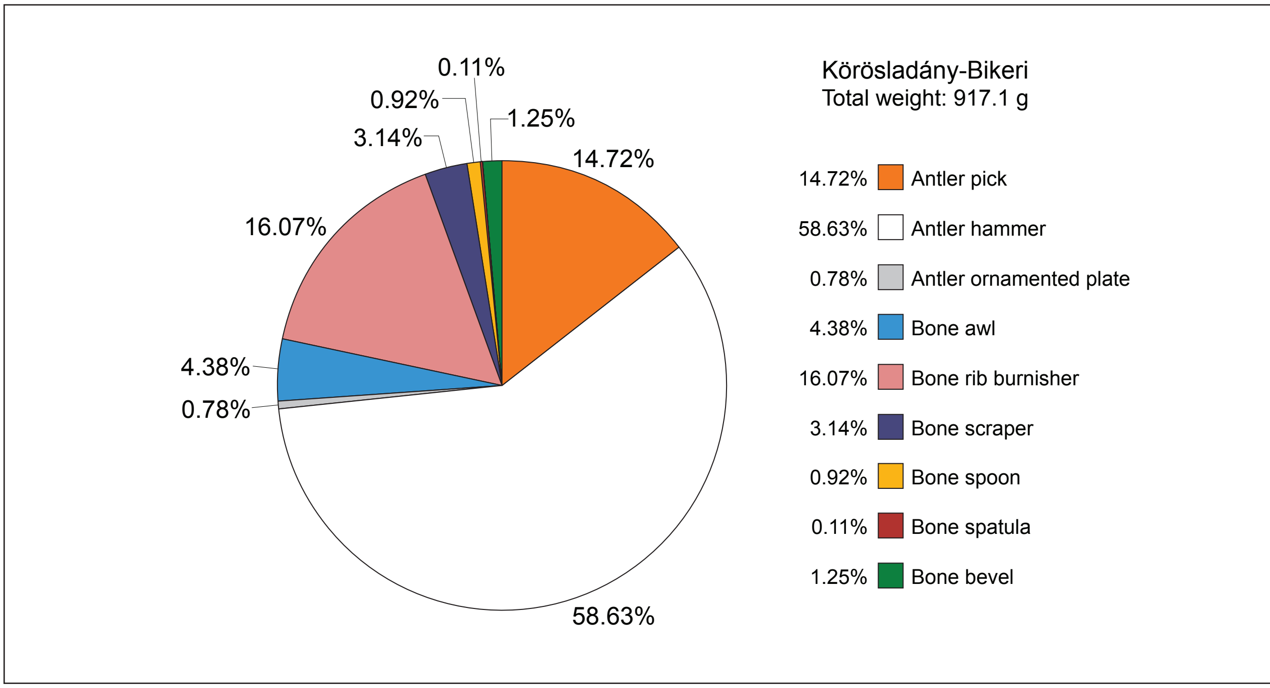


Figure 11.12. Relative abundance (by weight) of worked antler and bone tools from Körösladány-Bikeri. *Figure by Zsuzsanna Tóth.*

assemblage in terms of the quality of workmanship (Figure 11.13B). The final shape of the spoon was created by scraping with an edged chipped stone tool. Only the scraping marks are still visible on the bone surface. Thus, earlier steps in the manufacturing process cannot be reconstructed. The junction of the spoon and its handle is intact. This portion is decorated with three short, parallel, incised lines, whereas the spoon bowl has half-moon-shaped incisions arranged in a net design on its surface. Unfortunately, the exact shape of the spoon cannot be reconstructed from this fragmentary specimen, but the handle was short and conical, and the bowl seems to have been shallow and round. This specimen resembles the spoons from Early Neolithic Körös culture (circa 6000–5500 cal BC) sites more than spoons characteristic of Tiszapolgár contexts (Bognár-Kutzián 1963:307, 1972:135), although it does not have the V-shaped junction typical of Körös culture objects (Choyke 2007:Figure 29:7b).

Antler Tools

Three heavy-duty tools in the Körösladány-Bikeri assemblage were made of dense but resilient antler. One well-preserved pick and two hammers were collected at the site (Figure 11.14A). The pick was found in the fill of the deep outer ditch of the enclosure (Feature 2; see Chapter 7, this volume). It was made from the base of an antler rack. The rose has pockmarked battering on its surface. The eye-tine was removed and a hafting hole was drilled medio-laterally through the basal beam. The pick suffered heavy damage during its working lifetime; the entire lower part broke away along its axis as the result of being used.

One of the hammers was made from the rack of a hunted stag that was still attached to the skull when brought to the settlement after the hunt, whereas the other was made from a gathered shed antler. The bony part between the medallion and skull, the pedicle, was retained and shaped to become the active part of the hammer. The medallion was chopped all around, removing all the pearling and natural surface roughness. The eye-tine was removed and a hafting hole was drilled through it. This hammer probably was used as a hammer-pick or hammer-adze, but the other end has broken off so use cannot be ascertained directly. The second hammer is very fragmented, and thus the original shape cannot be determined.

Finally, there is a decorated antler object in the assemblage (Figure 11.14B). It is a long thin rod with two holes, resembling a handle fragment. Both ends are broken. The final shape was achieved by scraping with a chipped stone tool. All the cortical outer surfaces of the antler were first scraped, and then the holes were drilled as decoration. The decoration along the long axis of the artifact comprises small drilled dots arranged in three rows.

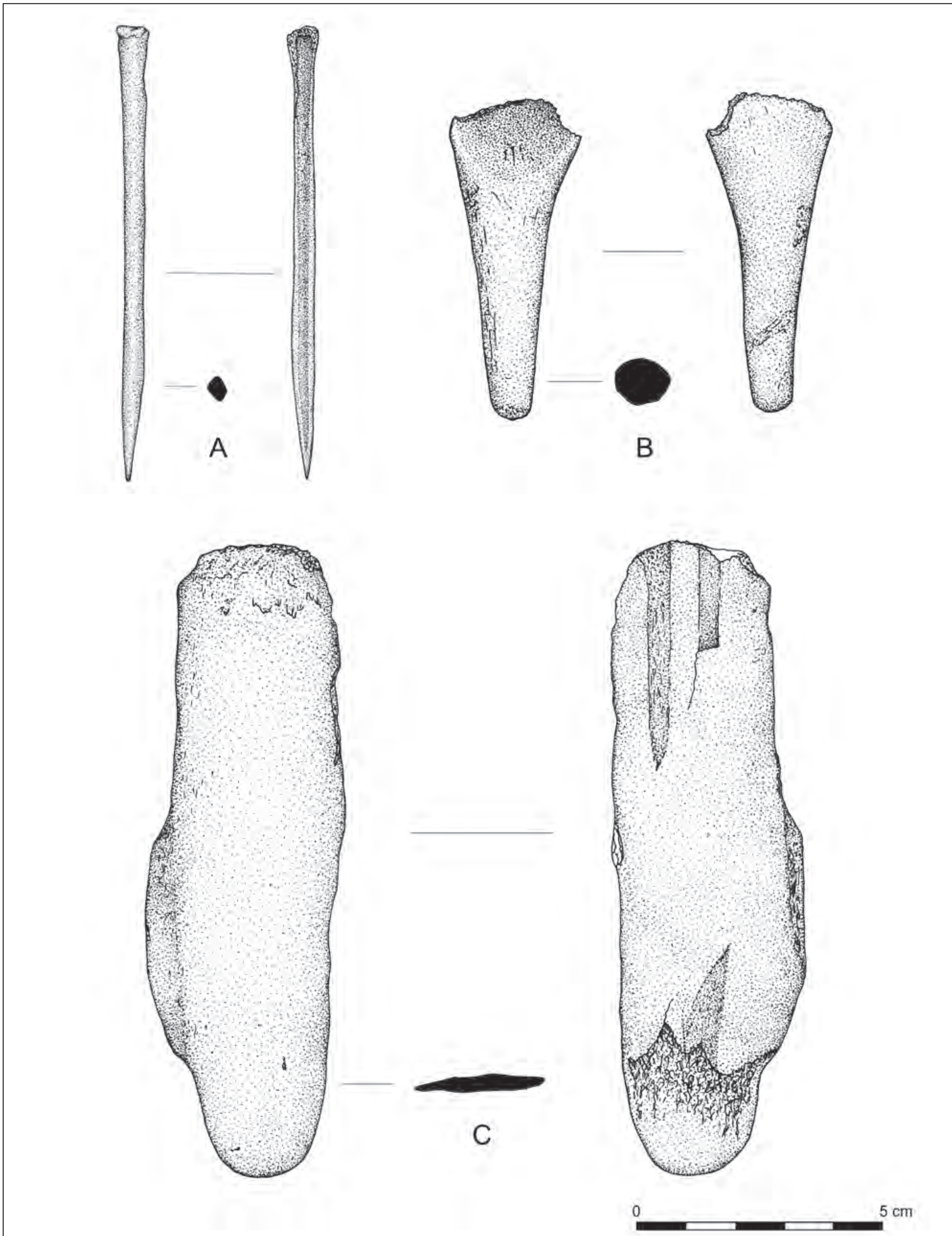


Figure 11.13. Bone tools from Körösladány-Bikeri. A: Quartered roe deer awl (Schibler Type 1/2a; K14SF168); B: Decorated spoon (K14SF166); C: Rib burnisher (K14SF295). *Figure by Dorottya Kékegyi.*

Discussion

The Arrowheads from Vésztő-Bikeri

All the arrowheads from Vésztő-Bikeri were burned, although the intensity of burning varied (Lyman 1994:384–92). Most are completely calcined while others are only partially burned, turning white, grayish blue, black, or gray spotted. Johnson (1989:441) distinguished four stages of burning. Based on her system, most of the arrowheads from Vésztő-Bikeri would fall into the final, fourth, stage, resulting in entire calcination, deformation, and the loss of all organic material. The Vésztő-Bikeri arrowheads often have cracks running along their longitudinal or horizontal axis. The intensity of burning also is expressed in plate-shaped pitting and micro-cracking. For many objects, the surface is chalky, obliterating all marks of manufacturing.

Most of the other objects in the antler and bone tool assemblages from the Bikeri sites do not display signs of burning. However, the single bone arrowhead found at Vésztő-Bikeri in the same Feature 4/14 longhouse context, just as the vast majority of calcinated antler arrowheads, was burned as well. Post-depositional damage traces on the antler and bone tools at both Bikeri sites, such as exposure to sun and rain while sitting on the ground surface or trampling, are similar to the taphonomic situation found at other prehistoric sites in Hungary. Gnawing marks and root etching can be seen on some of the tools.

Along with the cache of arrowheads, a considerable amount of debris, presumably associated with their manufacture (that is, burned antler fragments), also was found on the floor of the Feature 4/14 structure. Only two arrowheads were found in other contexts (Blocks 3 and 9) at Vésztő-Bikeri, indicating that projectile points were crafted in the Feature 4/14 building. In fact, the members of the Feature 4/14 household may have been engaged in specialized arrowhead production. Based on their presence, not only on the floor but also among the burned wall debris of the structure, the points likely were stored in bags or quivers that were hanging on the walls or from rafters at the time of the fire. Like the vitrified ceramics in Feature 4/14, these objects were scorched when the wattle-and-daub longhouse was burned.

The various types of arrowheads found at Vésztő-Bikeri likely were used for hunting and/or during violent intergroup conflicts. Production of varying formal types was certainly intentional, although whether different types of approximately equal size and weight were actually employed for different purposes remains unknown. Bradfield (2016) warned that form does not always equal function in his South African material. Pétriquin and Pétriquin (1990:487, footnote 7) noted that the functions usually attributed to each morphologically different arrow type were not very strictly observed during the hunt among the Ye-Ineri in Indonesia. Small bone arrowheads were recovered in and among human bones at the Mesolithic site of Schela Cladova in the Iron Gates of Romania (Choyke and Bartosiewicz 2004), and hafted chipped stone arrowheads—similar to the Type A specimens at Vésztő-Bikeri—are common at sites dating to the later Neolithic of the western Balkans and the Adriatic coast (Marton 2011). The use of bows and arrows is evident also during the Late Neolithic in the Carpathian Basin (Vörös 1987), although the artifact types interpreted as such could be used for different tasks as well. Copper Age chipped stone arrowheads were recovered on the Great Hungarian Plain from Middle Copper Age Bodrogkeresztúr culture contexts, but they are typologically distinct from the Bikeri arrowheads (Chapman 1999; Marton 2011; Patay 1974). Several of these Bodrogkeresztúr arrowheads were found in burials; they include an obsidian specimen that was embedded in the spine of an adult man (Gyucha et al. 2002), providing evidence for their use during armed conflicts.

Elsewhere, arrowheads commonly were made of more durable and less labor-intensive materials, such as chert and obsidian. This raises the question of why antler and bone were used as raw materials at Vésztő-Bikeri. The lithic assemblages from the Bikeri sites (see Chapter 12, this volume), as well as from other Early Copper Age sites in the Körös region (Gyucha 2015), suggest that, compared to the preceding Late Neolithic period, the Early Copper Age communities in the study area had more limited access to lithic raw materials and other exotic goods acquired through long-distance exchange (Gyucha and Parkinson 2013). The collapse of long-distance exchange networks at the end of the Neolithic may help explain why arrowheads made of antler and bone were substituted for chipped stone implements at Vésztő-Bikeri. Since Körösladány-Bikeri is the only other systematically excavated Early Copper Age Tiszapolgár settlement in the region, it remains unclear whether the Vésztő-Bikeri assemblage was part of a more widespread tradition for producing projectile points.

Continuity in Bone and Antler Tool Manufacturing

Bone and antler tool production methods documented at the Bikeri settlements emerged from Late Neolithic traditions. These traditions are characterized by highly structured species and skeletal element selection for raw materials as well as multistaged manufacturing processes by skilled artisans (Tóth 2013:Table 3). In the Neolithic

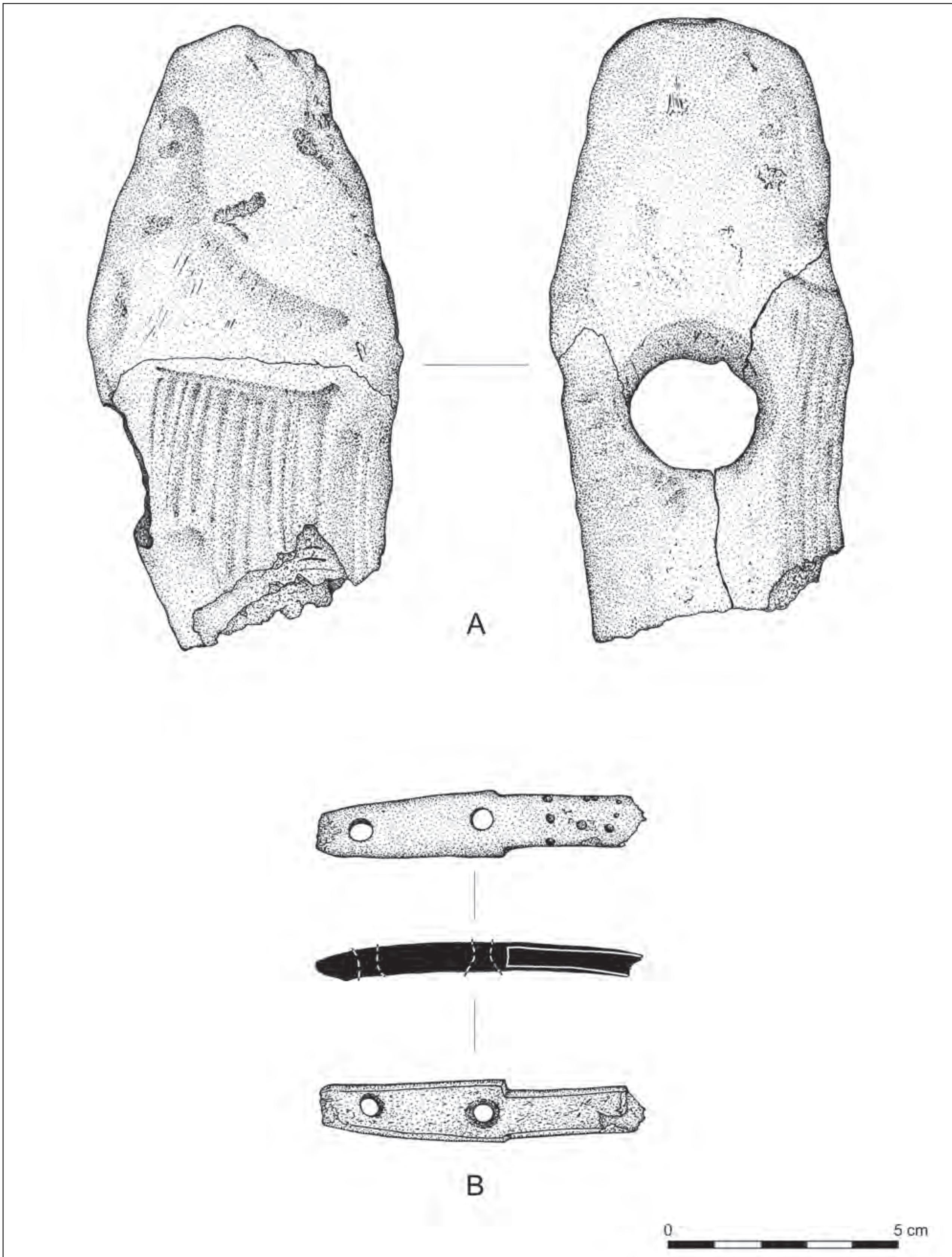


Figure 11.14. Antler tools from Körösladány-Bikeri. A: Hammer axe (K14SF158); B: Decorated rod (K14SF293). *Figure by Dorottya Kékegyi.*

period, more than 80 percent of bone awls were made from the metapodials of small ungulates (caprines or roe deer). The remaining 20 percent were made of other skeletal elements (for example, ulna, tibia, and fibula) and from other species, such as cattle, aurochs, red deer, dog, and hare. The groove and splinter technique was used to create most of the awl blanks and standardized tools (Choyke 1997:66). After the Late Neolithic, less consistent raw material and skeletal element selection, combined with a more simplified manufacturing process, yielded simpler tool types. When awl types are considered, there are more ad hoc pointed tools and fewer specimens made in the traditional manner at the Bikeri sites (like the quartered roe deer metapodial awls shown in Figures 11.3A and 11.13A; see also Choyke and Tóth 2013). Craftsmen spent less time producing standardized household implements. The majority of tools were made from bone splinters in the butchering refuse with low levels of modification.

Small ruminant metapodials (for example, from caprines and roe deer) were used predominantly in tool production during the Late Neolithic period. The inhabitants of the Early Copper Age Bikeri villages more frequently utilized longitudinal fragments of tibia, femur, or ulna shafts from small ungulates, such as caprines or pigs. These shaft fragments often were used to make awls and bevel-edged tools, continuing a trend that can already be observed in the Late Neolithic. However, standardized bone and antler tool production methods were replaced with simpler, ad hoc techniques during the Early Copper Age and in later periods (Choyke 2005, 2014).

Caprine bones are quite common in the faunal assemblages from the Bikeri villages (see Chapter 14, this volume), providing raw material for awl and beveled tool production. Red deer bone and antler, however, are relatively rare in these assemblages compared to the high proportion of tools made on antler. Although stags may have been present in the vicinity of the settlements, the faunal assemblages from the Bikeri sites demonstrate that red deer was not a primary source of meat (see Chapter 14, this volume). Nevertheless, shed antlers also could have been gathered for tool production with or without regular deer hunting.

Spatial Patterning

The distribution of bone and antler tools at Vésztő-Bikeri and Körösladány-Bikeri exhibits a remarkably regular pattern. The vast majority of awls and pointed bone tools were found in the central parts of the settlements. Most of these tools were recovered from the longhouses in Blocks 2 and 9 at Vésztő-Bikeri and from Block 4 at Körösladány-Bikeri, where several deep, bell-shaped pits were exposed (see Chapters 7 and 8, this volume). House remains were difficult to identify at Körösladány-Bikeri, and the majority of domestic refuse was excavated from large pit features surrounding the center of the site. Very few bone tools were discarded beyond these locations.

Heavy-duty antler tools, by contrast, commonly were recovered in the peripheries of the Bikeri villages. At Vésztő-Bikeri, the two antler specimens, a hammer and an axe/adze (see Figure 11.6), were found in Block 7, near the enclosure. Similarly, one of the hammer axes from Körösladány-Bikeri was excavated from the fill of Feature 2, the outer ditch of the enclosure (see Figure 11.14). However, the other hammer axe and a pick were recovered from the plowzone and a bell-shaped pit in Block 4, near the center of the settlement (Feature 5; see Chapter 7, this volume).

Conclusions

The current study provides the first insights into the production and use of worked bone and antler tools at Early Copper Age Tiszapolgár culture settlements. Antler arrowheads, unknown from other contemporaneous sites and cemeteries, account for nearly 92 percent of these artifacts in the Vésztő-Bikeri assemblage. The elaboration and typological variability of the arrowheads led us to infer that these artifact types were not developed at this site but rather were part of an established manufacturing tradition on the Great Hungarian Plain that previously had not been documented. Arrowheads tend either to be lost off-site or brought back in the carcass of game to be reused, or curated if broken. It is therefore not astonishing that they appear in low numbers at other sites; numbers that may not represent their true presence in the hunting paraphernalia at these settlements.

The majority of bone and antler tools in the two Bikeri assemblages are, typologically, remarkably similar and associated with everyday activities in these villages. Similar types of household tools, bone awls, burnishers, and bevels, as well as heavy-duty antler hammers, picks, axes, and adzes, also have been found commonly in residential contexts at other prehistoric sites across the Carpathian Basin (e.g., Gál 2012).

While some traditional production techniques and processes persisted, a decline in standardized manufacturing methods occurred after the end of the Late Neolithic in the Körös region. The social, economic, and cultural background of these developments will be better understood through the studies of additional Early Copper Age bone and antler tool assemblages from the Great Hungarian Plain.

Chapter 12

The Chipped Stone Assemblages

William A. Parkinson and Tibor Marton

In this chapter, we present the chipped stone artifacts recovered during excavations at Vésztő-Bikeri and from excavations and intensive, gridded survey at Körösladány-Bikeri, and we discuss their implications for modeling economic organization and long-distance exchange at the sites. The Bikeri assemblages are small compared to those from Neolithic sites in the region, suggesting a significant decrease in the use of chipped stones at the beginning of the Copper Age (Table 12.1). Despite the small size of the assemblages, they bear striking similarities to each other. The types and frequencies of nonlocal raw materials at both sites are nearly identical, as are the distributions of blank types and retouched tool types. This suggests that the same sources were being accessed for raw materials and that those materials were being processed in similar ways. The similarities in retouched tool types indicate that similar tasks were being carried out at both sites, and the spatial distribution of the artifacts suggests that these tasks were being performed at similar places within each settlement. As with other categories of artifacts (for example, ceramics and small finds) and ecofacts (for example, fauna), the chipped stone assemblages from Vésztő-Bikeri and Körösladány-Bikeri indicate a significant amount of continuity of Neolithic traditions into the Early Copper Age. The uncanny similarities between the material assemblages from the two chronologically overlapping, but sequential, sites lead us to argue that the same community occupied both sites.

Analytical Methods

All the chipped stone artifacts were analyzed macroscopically using a 16x hand lens. The authors based raw material designations upon macroscopically identifiable characteristics guided by extensive research dedicated to sourcing raw materials within the Carpathian Basin and throughout eastern Europe (e.g., Biró 1998a; Biró and Dobosi 1991). Typological attributes of the artifacts were entered into a database designed specifically for the assemblages using a modified version of the European Paleolithic typology consistent with that utilized for studying Neolithic and Copper Age assemblages in southeastern Europe (Brézillon 1971; Crabtree 1972; Kardulias and Runnels 1995; Movius et al. 1968; Parkinson and Cherry 2010; Perlès 1987).

Each artifact was assigned a blank type based upon formal characteristics that indicate the stage of the reduction sequence when the blank was removed from its parent material. Several different blank types were identified in the assemblages: flakes, blades, cores, and spalls. In the French classification scheme, "cores" are not technically considered blanks, but for the purposes of simplicity, they are included in the category with other blanks here. The majority of artifacts in the assemblages are flakes with

Table 12.1. Number of chipped stone artifacts by excavation block and volume at Vésztő-Bikeri and Körösladány-Bikeri

Excavation Block	Vésztő-Bikeri		Körösladány-Bikeri		Total
	N	Density (n/m^3)	N	Density (n/m^3)	
1	4	1.37	2	0.86	6
2	91	1.38	4	1.63	95
3	58	1.37	25	0.98	83
4	4	1.31	42	1.08	46
5	1	0.11	12	0.17	13
6	0	0.00	17	0.50	17
7	15	0.09	39	1.52	54
8	5	0.47	–	–	5
9	61	0.98	–	–	61
Surface	2	–	3	–	5
Total/Average	**241**	**0.79**	**144**	**0.96**	**385**

Table by William A. Parkinson.

Table 12.2. Blank type by site at Vésztő-Bikeri and Körösladány-Bikeri

Blank Type	Vésztő-Bikeri		Körösladány-Bikeri		Total
	N	%	N	%	
Blade	47	19.50	25	17.36	72
Blade Core	1	0.41	2	1.39	3
Flake Core	20	8.30	12	8.33	32
Lamellar Flake	2	0.83	5	3.47	7
Primary Flake	4	1.66	3	2.08	7
Secondary Flake	35	14.52	13	9.03	48
Spall	13	5.39	9	6.25	22
Tertiary Flake	119	49.38	75	52.08	194
Total	**241**	**100**	**144**	**100**	**385**

Table by William A. Parkinson.

varying amounts of cortex (Table 12.2). Within the blank typology, we differentiated three different flake types: primary, secondary, and tertiary. In our terminology, the dorsal surface of a primary flake is completely covered in a cortex or weathered rind, indicating that the flake was struck from the exterior portion of the natural nodule of raw material. Secondary flakes retain some cortex on their dorsal surfaces, together with some flake scars, suggesting that they too were removed from near the surface of the nodule. Tertiary flakes, on the other hand, bear no evidence of any cortex or weathered rind on their dorsal surfaces, which are completely covered in flake scars, indicating that such flakes were removed from closer to the interior of the nodule.

After flakes, blades comprise the second most common type of blank in the assemblages. Although a blade frequently is described as a flake that is twice as long as it is wide and with roughly parallel sides, it is useful to differentiate blades in this wider sense (here classified as blade-like lamellar flakes) from blades manufactured from prismatic blade cores, which are common in Neolithic and Copper Age lithic assemblages throughout southeastern Europe. It also is possible to distinguish different types of blades on the basis of whether their cross-sections are triangular or trapezoidal. This distinction permits the analyst to identify roughly at which stage the blade was removed during the reduction of the core, since trapezoidal blades derive from deeper within the blade core. Other blade types were also recorded. These include crested blades (*lamelle à crête*), which mark the initiation of the blade removal sequence.

We also identified several artifacts that are clearly anthropogenic but bear no identifiable formal characteristics that allow them to be assigned to any of the types described above. These artifacts most likely were flaking debris or debitage generated during the flaking process, and are referred to generically in this typology as spalls.

Retouch was described using a typology that distinguishes the type of retouch and its location on the artifact. Retouch types include nibbling, marginal, partial, invasive, and stepped. These types describe the degree to which the retouch is invasive into the piece. Nibbling, marginal, and partial retouch do not cross a dorsal ridge. Invasive retouch crosses a dorsal ridge, and stepped retouch is of the Quina type. Retouched artifact types are defined empirically, based on the distribution of retouch types and their locations on different blank types.

Specific information about each individual artifact was collected on a piece-by-piece basis, depending on the blank type, whether the piece was retouched, and the placement and type of the retouch on the artifact. For example, detailed information about platform or butt preparation, length, width, and thickness was recorded for cores, blades, and retouched pieces but not for unretouched flakes and spalls.

The assignment of raw material types was carried out by Marton. Parkinson carried out the typological classification.

Overview of the Assemblages

A total of 385 chipped stone artifacts were collected from Vésztő-Bikeri (n = 241) and Körösladány-Bikeri (n = 144). Despite the differences in absolute quantities of chipped stone artifacts from each site, the numbers reflect remarkably similar artifact densities (Table 12.1). Although difficult to quantify, these densities of chipped stone are significantly lower than those from Late Neolithic sites on the Great Hungarian Plain. The excavations at Öcsöd-Kováshalom (Kaczanowska et al. 2009), for example, produced approximately 6,000 pieces of chipped stone. The assemblage from Hódmezővásárhely-Gorzsa also numbers in the thousands (Biró 1998a:196–201; Starnini et al. 2007). Within the Körös region, our own surface collections indicate similar trends. During two seasons of gridded surface collections at the Late Neolithic site of Szeghalom-Kovácshalom, we collected 1,235 pieces of chipped stone, weighing nearly 7 kg. In general, sites with substantial Late Neolithic habitations have much denser lithic concentrations than Early Copper Age sites, although there is significant variation in the relative frequency of raw materials at Early Copper Age sites within the region (Gyucha 2015:364).

The chipped stone assemblages from the Bikeri sites are strikingly similar in nearly every respect, suggesting that the assemblages were generated by communities with similar access to trade networks and, therefore, raw material sources. The reduction sequences from those different materials indicate that the raw materials were arriving at the sites in a similar manner (Table 12.2; Figure 12.1). Finally, the formal tool types produced, as well as their distribution across the settlements, suggest that similar activities were being carried out with the chipped stone objects. These uncanny similarities lead us to infer that the assemblages were produced by the same group that moved from one site to the other.

The lack of adequately published lithic assemblages from excavations at Early Copper Age sites on the Great Hungarian Plain makes it difficult to place these patterns into a broader, synchronous context. Information from systematic surveys and excavations exists, but only small portions of the assemblages have been published.

Lithic Raw Materials

The distribution of raw material sources throughout the Carpathian Basin has been studied by several scholars, and many of the major sources have been characterized petrographically and chemically (e.g., Biró 1998a, 1998b; Biró et al. 2000). These studies, combined with the complete lack of lithic raw material sources on the Great Hungarian Plain, make the Körös region ideal for studying ancient networks of trade and exchange.

The lithic assemblages from both Bikeri sites are dominated by obsidian (Table 12.3), which, based on macroscopic identification, appears to derive from the northern Carpathians. Obsidian comprises 41 percent of the assemblage from Vésztő-Bikeri (n = 100) and 45 percent of the assemblage from Körösladány-Bikeri (n = 65; see Table 12.3). The second most frequent raw materials are hydroquartzite (Vésztő-Bikeri, n = 32, 14 percent; Körösladány-Bikeri, n = 27, 19 percent) and Volhynian flint (Vésztő-Bikeri, n = 38, 16 percent; Körösladány-Bikeri, n = 21, 15 percent). The chert category in Table 12.3 includes a variety of different raw materials. The other raw materials represented in the Bikeri assemblages include commonly exploited siliceous rocks available within the Carpathian Basin; a few, such as the Banat and central Balkan cherts, derive from the central and southern Balkans.

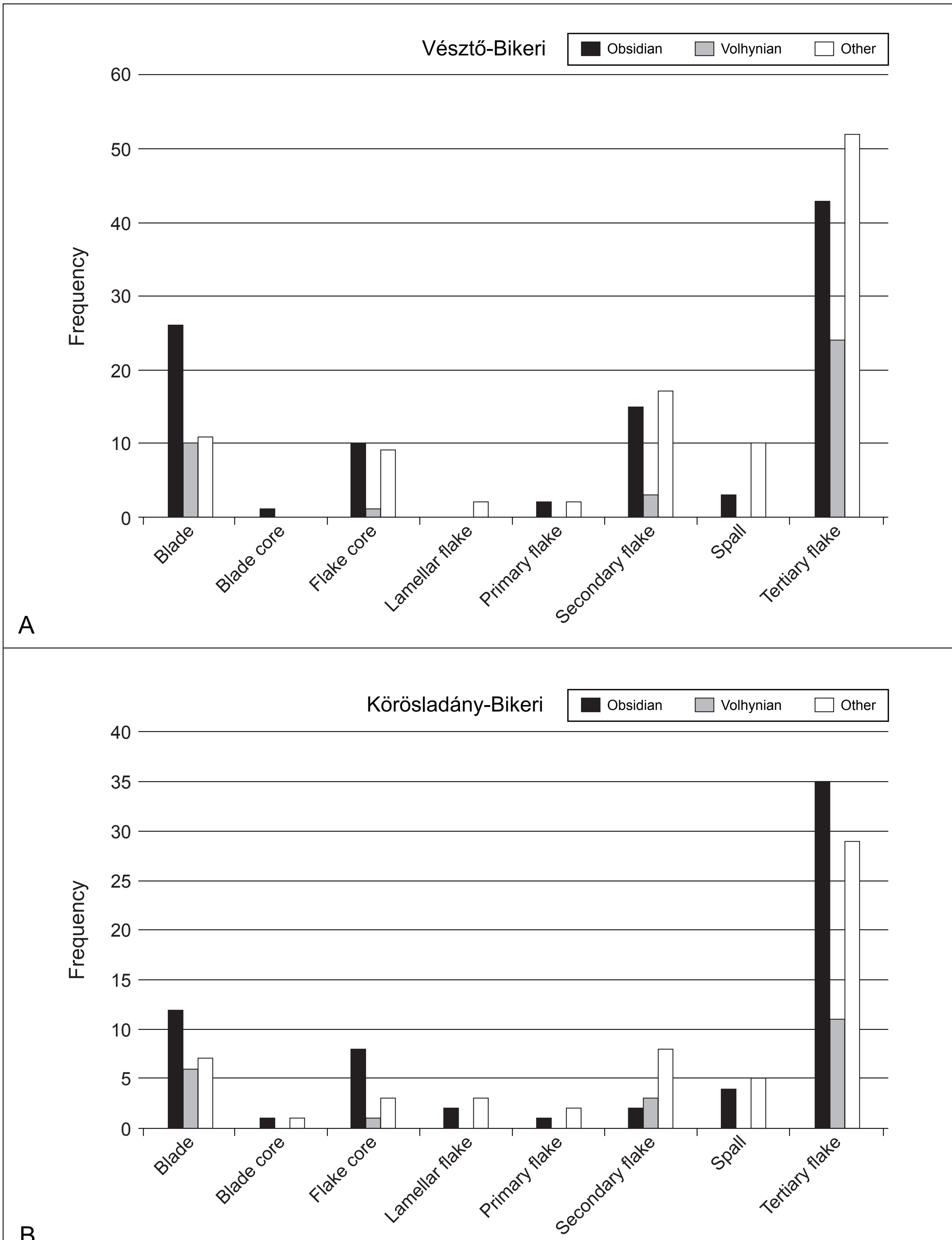


Figure 12.1. Frequencies of raw materials by blank type. A: Vésztő-Bikeri; B: Körösladány-Bikeri. *Figure by William A. Parkinson and Jill Seagard.*

Table 12.3. Raw material types by site at Vésztő-Bikeri and Körösladány-Bikeri

Raw Material	Vésztő-Bikeri		Körösladány-Bikeri	
	N	%	N	%
Banat	3	1.24	1	0.69
Central Balkan	0	0.00	1	0.69
Chert	33	13.69	16	11.11
Granite	4	1.66	0	0.00
Hydroquartzite	32	13.28	27	18.75
Jasper	2	0.83	0	0.00
Limestone	2	0.83	2	1.39
Limnoquarzite	1	0.41	0	0.00
Mecsek?	1	0.41	0	0.00
Mezőzombor	5	2.07	5	3.47
Obsidian	100	41.49	65	45.14
Opal	3	1.24	0	0.00
Orthoquartzite	1	0.41	0	0.00
Quartzite	15	6.22	5	3.47
Radiolarite	0	0.00	1	0.69
Sandstone	1	0.41	0	0.00
Volhynian	38	15.77	21	14.58
Total	**241**	**100**	**144**	**100**

Table by William A. Parkinson and Tibor Marton.

A wider variety of raw material sources is represented in the assemblage at Vésztő-Bikeri (n = 15) than at Körösladány-Bikeri (n = 10), but this likely is due to the larger size of the assemblage at Vésztő-Bikeri (Table 12.1). Raw materials represented only in the Vésztő-Bikeri assemblage occur in very low frequencies and therefore are likely due to the more robust sample size.

Detailed descriptions of these raw material sources are available in Biró (1998a, 1998b) as well as in the Lithotheca volumes (Biró and Dobosi 1991; Biró et al. 2000). Briefly, Carpathian obsidian sources are located in southern Slovakia (Carpathian 1) and northeastern Hungary (Carpathian 2). The hydro- and limnoquartzites most likely derive from the region of Tokaj and the Mátra Mountains and possibly also from the Szerencs Mountains. The Volhynian/Prut (northern) flint sources are in southern Poland. With the exception of the Banat and Balkan (southern) cherts, the remaining materials most likely originate from elsewhere in the Carpathians. Noticeably absent in significant quantities is Mecsek radiolarite, which occurs in high frequencies in Late Neolithic contexts at Hódmezővásárhely-Gorzsa (Starnini et al. 2007:273). A higher frequency of hydro- and limnoquartzites also occurs at the early Tisza site of Öcsöd-Kováshalom (Kaczanowska et al. 2009) and in Early Neolithic Körös contexts at Ecsegfalva 23 (Mateiciucová 2007). Importantly, obsidian also occurs in appreciable frequencies at Ecsegfalva 23 (about 30 percent) but not at the Late Neolithic settlement of Öcsöd-Kováshalom.

The assemblages from the Bikeri settlements exhibit significantly less variation in the quantities of raw material types represented than those from Late Neolithic sites, although the overall lack of analyzed and published assemblages from other Early Copper Age sites makes it difficult to determine the extent to which this pattern occurred more commonly during the time period. The relative frequencies exhibited in Late Neolithic assemblages vary a great deal regionally and suggest a significant amount of variation in the organization of trade contacts from region to region and perhaps even from site to site during that period (e.g., Biró 1998a). Hence the pattern of relative homogeneity exhibited between the two Bikeri assemblages is all the more striking.

Table 12.4. Raw material types by blank type at Vésztő-Bikeri

Raw Material	Blade	Blade Core	Flake Core	Lamellar Flake	Primary Flake	Secondary Flake	Spall	Tertiary Flake	Total
Banat	1	0	0	0	0	1	0	1	3
Chert	8	0	2	0	1	2	3	17	33
Granite	0	0	0	0	0	0	0	4	4
Hydroquartzite	1	0	4	1	0	5	3	18	32
Jasper	0	0	1	0	0	0	1	0	2
Limestone	0	0	0	1	0	0	0	1	2
Limnoquarzite	0	0	0	0	0	1	0	0	1
Mecsek?	0	0	0	0	0	1	0	0	1
Mezőzombor	1	0	1	0	0	2	1	0	5
Obsidian	26	1	10	0	2	15	3	43	100
Opal	0	0	0	0	0	1	0	2	3
Orthoquartzite	0	0	0	0	0	0	0	1	1
Quartzite	0	0	1	0	1	4	2	7	15
Sandstone	0	0	0	0	0	0	0	1	1
Volhynian	10	0	1	0	0	3	0	24	38
Total	**47**	**1**	**20**	**2**	**4**	**35**	**13**	**119**	**241**

Table by William A. Parkinson and Tibor Marton.

Chaînes Opératoires

The similarity exhibited in the frequencies of raw materials at Vésztő-Bikeri and Körösladány-Bikeri also is reflected in the *chaînes opératoires*, as indicated by the reduction sequences (Table 12.2), even when blank types are compared to raw material types (Tables 12.4–12.5; Figure 12.1). Both assemblages are severely reduced, with the entire reduction sequence represented in most of the material types.

Both assemblages are dominated by flakes, especially non-cortical tertiary flakes, which comprise about 50 percent of each assemblage (Vésztő-Bikeri, 49 percent; Körösladány-Bikeri, 52 percent; see Table 12.2; Figures 12.2–12.8). Secondary and primary flakes occur in significantly smaller percentages, suggesting that most raw materials arrived at the site having been roughed out elsewhere, probably through systems of down-the-line exchange. There are relatively fewer secondary flakes and more tertiary flakes in the Körösladány-Bikeri assemblage, perhaps related to more off-site reduction, especially in obsidian (Figure 12.1). Although the sites overlap chronologically, Körösladány-Bikeri was occupied after Vésztő-Bikeri was abandoned, and this may be indicative of more restricted access to obsidian later in the Early Copper Age.

After flakes, blades comprise the next most common blank type (Figure 12.3). There are proportionally more blades on obsidian at Vésztő-Bikeri (n = 26, 55 percent of all blades at the site) than at Körösladány-Bikeri (n = 12, 48 percent). Conversely, there are slightly more blades on Volhynian flint at Körösladány-Bikeri (n = 6, 24 percent of all blades at the site) than at Vésztő-Bikeri (n = 10, 21 percent). It remains unclear whether this is related to the more robust sample collected from Vésztő-Bikeri or to subtle—perhaps diachronic—changes in the trade networks. Given the small size of the assemblages and the context-based variation in other material classes (see Chapters 11, 13–15, this volume), we are reluctant to view this as a significant pattern.

The chipped stone artifacts in both Bikeri assemblages are hyper-reduced (Figure 12.2), with mean widths of less than 15 mm and mean lengths of less than 20 mm (including cores). Most cores, and many larger flakes that were turned into cores, were reduced using intensive bipolar percussion techniques (see Figures 12.2C and 12.5F). Artifacts on Volhynian flint are slightly larger than those made on obsidian at both sites, suggesting that obsidian was even more intensively reduced. This can be due to either the relative

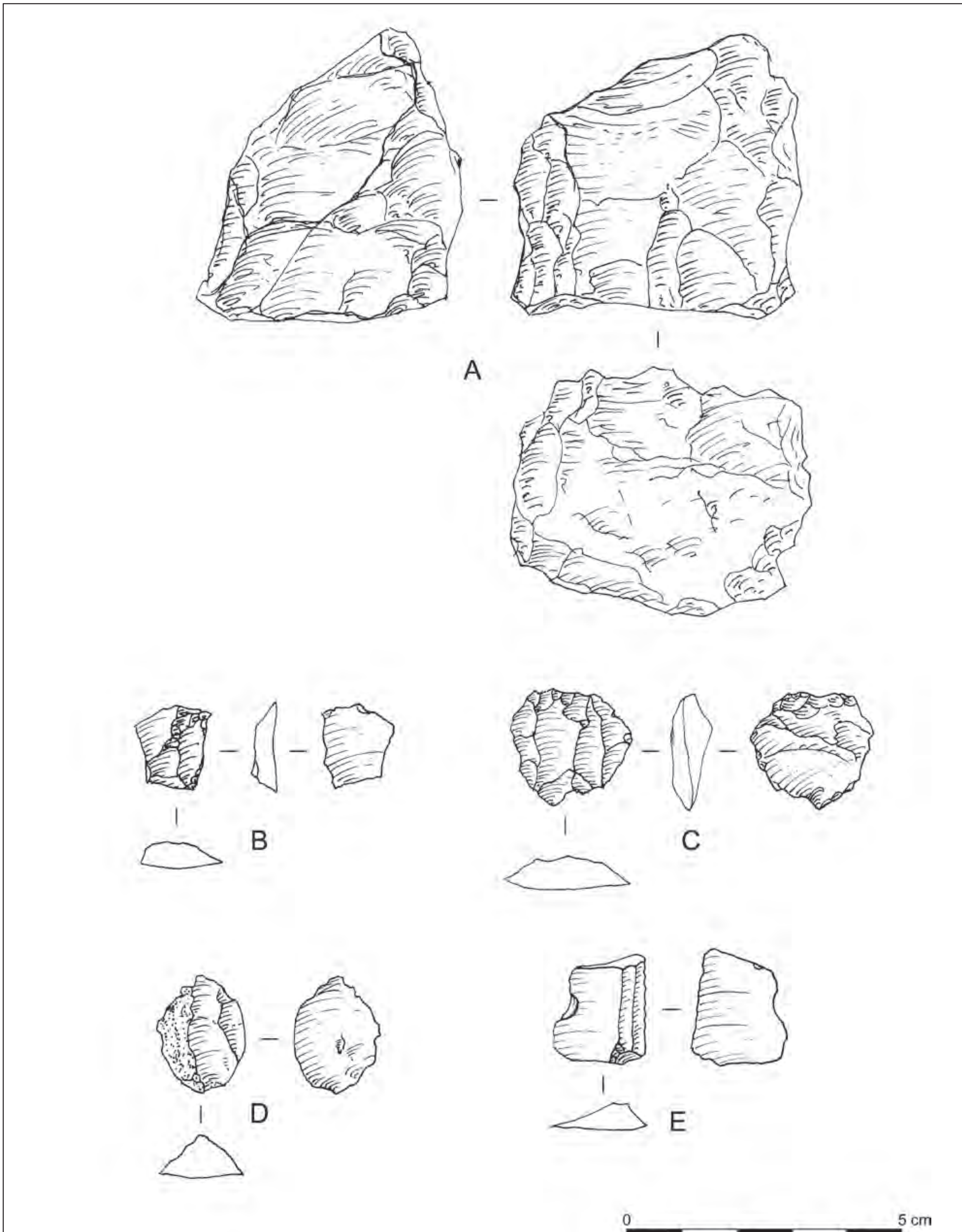


Figure 12.2. Cores and flakes on hydro- or limno-quartzite (A) and obsidian (B–E) from Vésztő-Bikeri. A: Hydro- or limnoquartzite, flake core (V20SF497); B: Obsidian, bipolar core with retouch (V20SF312); C: Obsidian, bipolar core with retouch (V20SF323); D: Obsidian, secondary flake (V20SF025); E: Obsidian, tertiary flake with notch (V20SF154). *Figure by Dorottya Kékegyi, Tibor Marton, and Jill Seagard.*

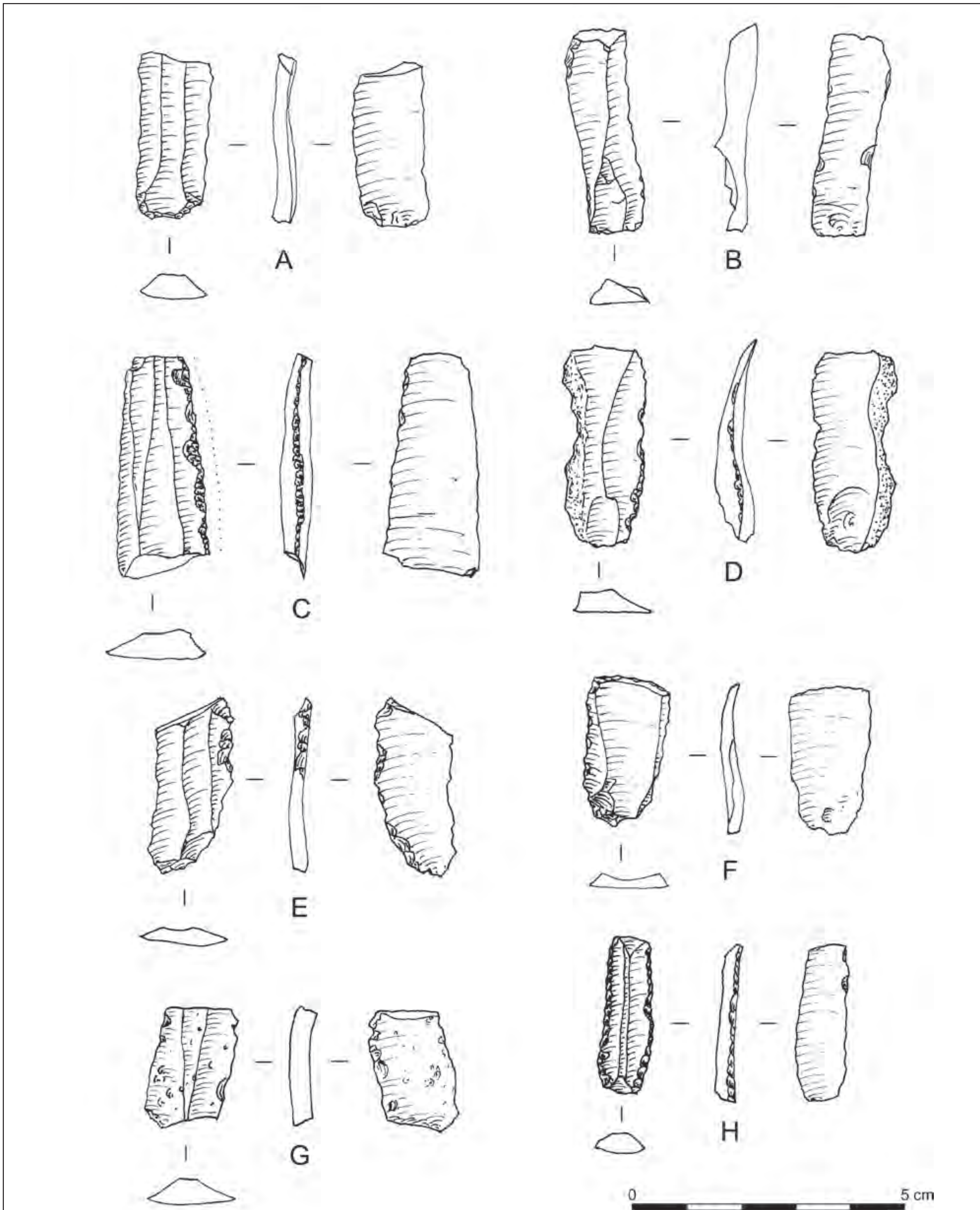


Figure 12.3. Retouched chert artifacts from Vésztő-Bikeri. A: Mecsek radiolarite, trapezoidal blade (V20SF396); B: Central Banat chert, triangular blade with retouch (V20SF393); C: Volhynian flint, sidescraper on trapezoidal blade (V20SF383); D: Mezőzombor limnoquartzite, sidescraper on secondary flake (V20SF379); E: Volhynian flint retouched sickle fragment (V20SF369); F: Mecsek radiolarite, retouched sickle fragment (V20SF158); G: White chert, medial blade fragment with notch (V20SF310); H: Volhynian flint, trapezoidal blade with retouch (V20SF274). *Figure by Dorottya Kékegyi, Tibor Marton, and Jill Seagard.*

Table 12.5. Raw material types by blank type at Körösladány-Bikeri

Raw Material	Blade	Blade Core	Flake Core	Lamellar Flake	Primary Flake	Secondary Flake	Spall	Tertiary Flake	Total
Banat	0	0	0	1	0	0	0	0	1
Central Balkan	0	0	0	0	0	0	0	1	1
Chert	2	0	0	0	1	1	3	9	16
Hydroquartzite	5	1	2	2	0	6	1	10	27
Limestone	0	0	0	0	1	0	0	1	2
Mezőzombor	0	0	1	0	0	1	0	3	5
Obsidian	12	1	8	2	1	2	4	35	65
Quartzite	0	0	0	0	0	0	1	4	5
Radiolarite	0	0	0	0	0	0	0	1	1
Volhynian	6	0	1	0	0	3	0	11	21
Total	**25**	**2**	**12**	**5**	**3**	**13**	**9**	**75**	**144**

Table by William A. Parkinson and Tibor Marton.

Table 12.6. Number and frequency of retouched and unretouched pieces at Vésztő-Bikeri and Körösladány-Bikeri

Retouch Frequency	Vésztő-Bikeri		Körösladány-Bikeri		Total
	N	%	N	%	N
Retouched	78	32	44	31	241
Unretouched	163	68	100	69	144
Total	**241**	**100**	**144**	**100**	**385**

Table by William A. Parkinson.

value of obsidian as a raw material or the types of tools made on the different raw materials.

Tool Types

Astonishingly, despite the small size of the heavily reduced assemblages, the frequency of retouch by raw material at the two sites is nearly identical (Tables 12.6–12.7). The retouched percentages of the total lithic assemblage at both sites are 31–32 percent. When broken down by raw material type, the percentage of retouched pieces remains identical, indicating similar intensity of use and curation of different raw materials at the settlements (Table 12.7; Figures 12.2–12.8).

The distribution of retouched tool types (Tables 12.8–12.9) reflects some differences between the assemblages. Both assemblages are dominated by unclassified retouched pieces and endscrapers (Figure 12.4), with a few other formal tool types represented.

The obsidian assemblages at both sites include retouched blades and flakes as well as sidescrapers, endscrapers, becs, a backed piece, and notches (Figures 12.2–12.8). The intensively reduced nature of the obsidian artifacts likely contributes to the slightly higher number of unclassified retouched pieces in both assemblages. Retouched tools on Volhynian flint include a slightly higher percentage of endscrapers in the assemblages as well as sickle elements, sidescrapers, multiple tools, a burin, and a notch. The overall picture is that of severely exhausted ad hoc assemblages with a few formal tool types that, nevertheless, represent a wide range of activities.

Table 12.7. Number and frequency of retouched pieces by material type at Vésztő-Bikeri and Körösladány-Bikeri

Raw Material	Vésztő-Bikeri		Körösladány-Bikeri		Total
	N	%	N	%	
Obsidian	32	41.03	18	40.91	50
Volhynian	21	26.92	12	27.27	33
Other	25	32.05	14	31.82	39
Total	**78**	**100**	**44**	**100**	**122**

Table by William A. Parkinson and Tibor Marton.

Table 12.8. Retouched tool types, blades, and platform rejuvenation flakes by material type at Vésztő-Bikeri

Count / Row %	Backed Piece	Bec	Un-retouched Blade	Re-touched Blade	Borer	Burin	Burin Spall	Crest Blade	End-scraper	Multiple Tool	Notch	Re-touched Piece	Sickle Element	Side-scraper	Trans-verse Scraper	Total
Obsidian	1 2.70	2 5.41	11 29.73	3 8.11	1 2.70	0 0.00	1 2.70	0 0.00	1 2.70	0 0.00	5 13.51	8 21.62	0 0.00	2 5.41	2 5.41	37
Volhynian	0 0.00	0 0.00	1 5.88	0 0.00	0 0.00	1 5.88	0 0.00	0 0.00	5 29.41	2 11.76	1 5.88	5 29.41	1 5.88	1 5.88	0 0.00	17
Other	0 0.00	1 5.00	1 5.00	0 0.00	0 0.00	0 0.00	0 0.00	1 5.00	2 10.00	2 10.00	2 10.00	5 25.00	1 5.00	5 25.00	0 0.00	20
Total Row %	**1** **1.35**	**3** **4.05**	**13** **17.57**	**3** **4.05**	**1** **1.35**	**1** **1.35**	**1** **1.35**	**1** **1.35**	**8** **10.81**	**4** **5.41**	**8** **24.32**	**18** **2.70**	**2** **2.70**	**8** **10.81**	**2** **2.70**	**74** **100**

Table by William A. Parkinson and Tibor Marton.

Table 12.9. Retouched tool types, blades, and platform rejuvenation flakes by material type at Körösladány-Bikeri

Count / Row %	Bec	Un-retouched Blade	Retouched Blade	Burin Spall	Endscraper	Multiple Tool	Notch	Percoir	Platform Rejuvenation Flake	Re-touched Piece	Sickle Element	Side-scraper	Total
Obsidian	0 0.00	4 18.18	2 9.09	1 4.55	2 9.09	0 0.00	3 13.64	0 0.00	1 4.55	7 31.82	0 0.00	2 9.09	22
Volhynian	0 0.00	1 7.69	0 0.00	0 0.00	5 38.46	1 7.69	0 0.00	0 0.00	1 7.69	2 15.38	2 15.38	1 7.69	13
Other	1 7.14	1 7.14	0 0.00	0 0.00	5 35.71	0 0.00	3 21.43	1 7.14	0 0.00	1 7.14	1 7.14	1 7.14	14
Total Row %	**1** **2.04**	**6** **12.24**	**2** **4.08**	**1** **2.04**	**12** **24.49**	**1** **2.04**	**6** **12.24**	**1** **2.04**	**2** **4.08**	**10** **20.41**	**3** **6.12**	**4** **8.16**	**49** **100**

Table by William A. Parkinson and Tibor Marton.

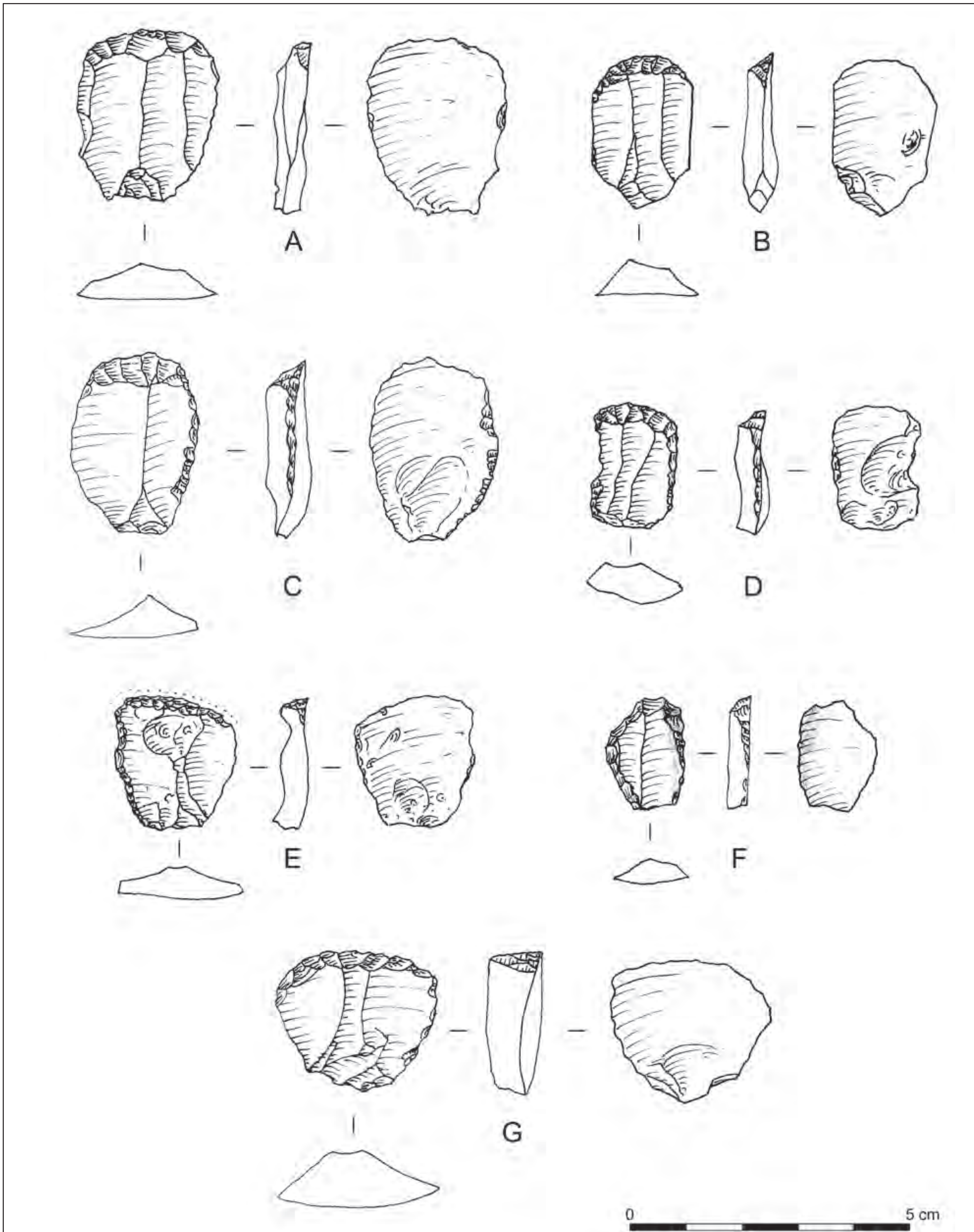


Figure 12.4. Retouched chert artifacts from Vésztő-Bikeri. A: Mecsek radiolarite, endscraper on tertiary flake (V20SF134); B: Mecsek radiolarite, endscraper on tertiary flake (V20SF404); C: Volhynian flint, multiple tool on tertiary flake (V20SF420); D: Volhynian flint, multiple tool on tertiary flake (V20SF409); E: Mecsek radiolarite, endscraper on tertiary flake (V20SF416); F: Hydro- or limnoquartzite, backed sickle fragment (V20SF419); G: Volhynian flint, endscraper on tertiary flake (V20SF425). *Figure by Dorottya Kékegyi, Tibor Marton, and Jill Seagard.*

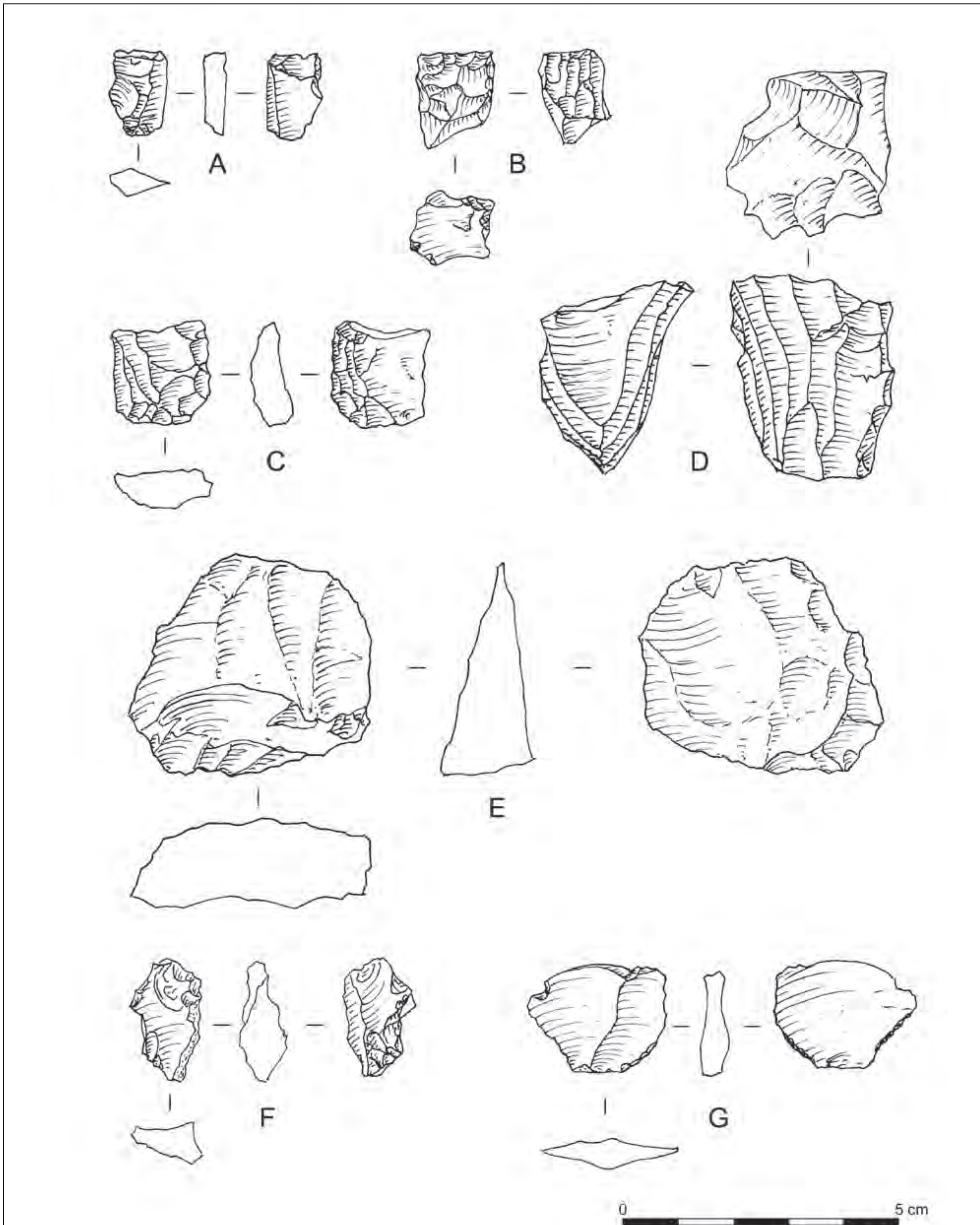


Figure 12.5. Cores and flakes from Körösladány-Bikeri. A: Obsidian, bipolar core (K14SF140); B: Obsidian, bipolar core (K14SF041); C: Reddish chert, bipolar core (K14SF019); D: Volhynian flint, bladelet core (K14SF042); E: Hydro- or limnoquartzite, platform rejuvenation flake (K14SF043); F: Obsidian, bipolar core fragment (K14SF233); G: Volhynian flint, tertiary flake (K14SF005). *Figure by Dorottya Kékegyi, Tibor Marton, and Jill Seagard.*

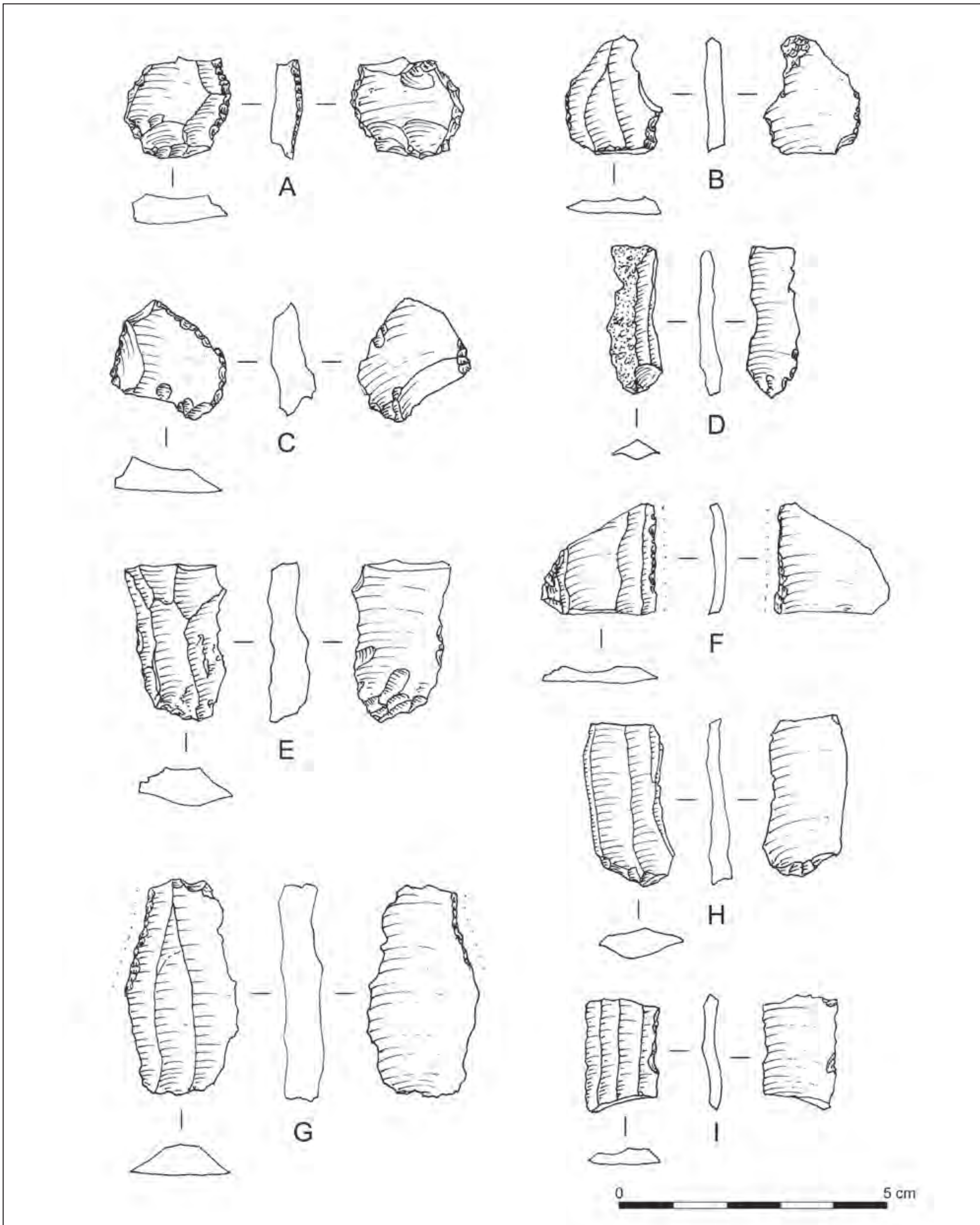


Figure 12.6. Chipped stone artifacts from Körösladány-Bikeri. A: Obsidian, bipolar core with retouch (K14SF226); B: Volhynian flint, tertiary flake (K14SF126); C: Obsidian, tertiary flake with retouch (K14SF130); D: Obsidian, secondary blade fragment (K14SF134); E: Mátra Jasper, tertiary flake with bec (K14SF210); F: Obsidian, sidescraper on tertiary flake (K14SF272); G: Volhynian flint, lamellar flake with retouch (K14SF277); H: Volhynian flint, trapezoidal blade fragment (K14SF242); I: Hydro- or limnoquartzite, medial blade fragment (K14SF228). *Figure by Dorottya Kékegyi, Tibor Marton, and Jill Seagard.*

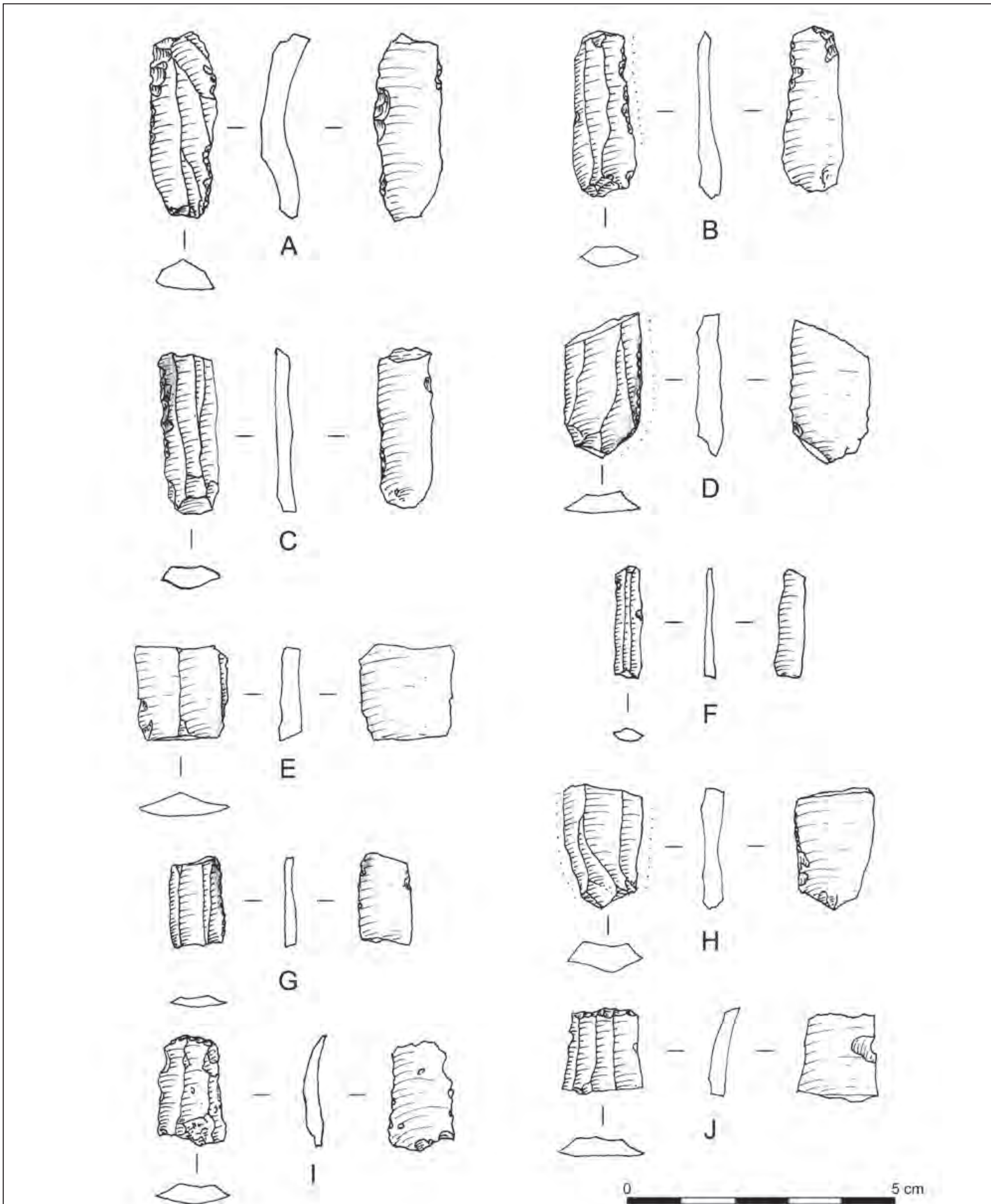


Figure 12.7. Chipped stone artifacts from Körösladány-Bikeri. A: Obsidian, trapezoidal blade with irregular retouch (K14SF276); B: Obsidian, trapezoidal blade with retouch (K14SF264); C: Volhynian flint, trapezoidal blade with retouch and sickle sheen (K14SF262); D: Volhynian flint, trapezoidal blade fragment with sickle sheen (K14SF135); E: Hydro- or limnoquartzite, blade fragment with sickle sheen (K14SF223); F: Mecsek radiolarite, trapezoidal blade fragment (K14SF298); G: Volhynian flint, trapezoidal blade fragment with sickle sheen (K14SF246); H: Mecsek radiolarite, trapezoidal blade fragment (K14SF298); I: White chert, endscraper on tertiary blade (K14SF092); J: Obsidian, endscraper on blade (K14SF282). *Figure by Dorottya Kékegyi, Tibor Marton, and Jill Seagard.*

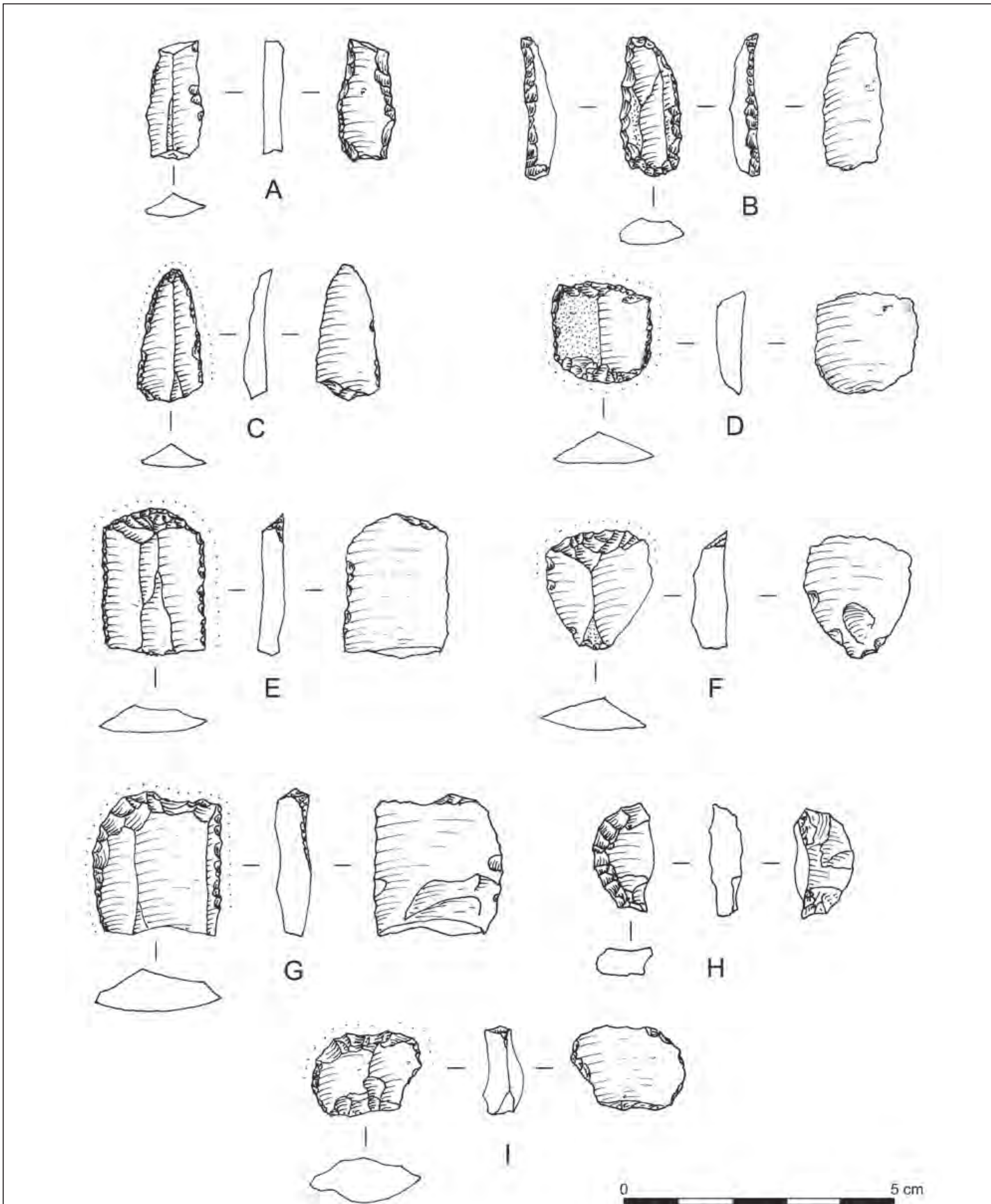


Figure 12.8. Chipped stone artifacts from Körösladány-Bikeri. A: Obsidian, blade with retouch (K14SF209); B: Hydro- or limnoquartzite, retouched secondary flake (K14SF059); C: Volhynian flint, triangular blade with retouch and sickle sheen (K14SF216); D: Volhynian flint, sickle on secondary flake (K14SF035); E: Volhynian flint, endscraper on trapezoidal blade (K14SF006); F: Volhynian triangular blade, endscraper on secondary flake (K14SF029); G: Volhynian flint, multiple tool on tertiary flake (K14SF206); H: Obsidian, endscraper on retouched bipolar core fragment (K14SF196); I: Volhynian flint, endscraper on tertiary flake (K14SF089). *Figure by Dorottya Kékegyi, Tibor Marton, and Jill Seagard.*

The Bikeri Chipped Stone Assemblages in Context

Gyucha (2015:266–70) discussed the raw material distributions from the Bikeri sites in the broader context of the Körös region. Investigations at two other Early Copper Age sites in the eastern Körös region—Gyula-Remete-Iskola and Geszt-Szalontai-zug—produced chipped stone assemblages that can be compared to the Bikeri assemblages. The small assemblage (n = 28) from Gyula-Remete-Iskola was recovered from Early Copper Age contexts during salvage excavations, and the collection from Geszt-Szalontai-zug (n = 112) was recovered during systematic surface surveys over the course of Gyucha's dissertation research. Volhynian flint comprises about 60 percent of both assemblages, leading Gyucha to propose that these sites in the eastern part of the Körös region were integrated into an interaction sphere that linked them into a northeastern-oriented network that brought more Volhynian chert than obsidian into the sites, continuing a tradition established with Late Neolithic Herpály sites (Biró 1998a:52, 56). Elsewhere, Gyucha and Parkinson (2013) have argued that this pattern may be a residual of the social boundary that during the Late Neolithic separated the Tisza and Herpály into discrete archaeological groups. In contrast to the actively maintained social boundaries of the Late Neolithic, however, the boundaries in the Early Copper Age became less rigid and more permeable as settlements became smaller, more dispersed, and less tethered to central "nodes" (that is, tells and tell-based settlement complexes).

Most lithic studies in the Carpathian Basin have focused on raw material analysis (e.g., Biró 1998a, 1998b) not on the typological or technological analysis of individual assemblages, making intersite comparisons of this sort difficult. Although typological studies exist, especially for earlier periods (for example, the Early Neolithic; see Mateiciucová 2007), extensive, systematic typological studies are rare even for Late Neolithic sites on the Great Hungarian Plain. Kaczanowska et al. (2009) published the assemblage from the Early Tisza site of Öcsöd-Kováshalom, and Starnini et al. (2007) published a preliminary report on some of the chipped stone material from different levels at Hódmezővásárhely-Gorzsa.

The assemblage from Polgár-Bosnyákdomb is one of the few sizable chipped stone assemblages that has been systematically studied and published, and also is chronologically close to the Bikeri sites (Kozłowski and Kaczanowska 2009). Originally regarded as a Proto-Tiszapolgár settlement (Raczky and Anders 2009), judging from ceramic stylistic attributes, the site chronology was reconsidered on the basis of radiocarbon dates (Raczky and Anders 2016). These dates put the occupation of the site between 4600 and 4400 cal BC, and the ceramics from the site have characteristics typical of both Late Neolithic and Early Copper Age assemblages. The utility of the Proto-Tiszapolgár concept notwithstanding (see Chapter 9, this volume), the site indicates continuity with Late Neolithic traditions in the Csőszhalom region during the chronological transition to the Copper Age.

The lithic assemblage from Polgár-Bosnyákdomb included 376 artifacts from a single structure and another 342 from the cultural layer above the house. The assemblage indicates strong continuity with the preceding phase in the region in terms of both raw materials and technological and typological affinities. The most frequent raw materials used for chipped stone at the site are cherts of unknown origin, followed by limnoquartzites, then obsidian (12–17 percent), which occurs in higher frequencies in the later context at the site. Volhynian flint occurs in a very low percentage (4.5–7 percent) but also increases by the later phase of occupation. The Bikeri assemblages, located much farther from both the obsidian and the Volhynian sources than Polgár-Bosnyákdomb, have significantly higher frequencies of both materials. It remains unclear whether this is related to regional or chronological patterning during the transition to the Copper Age, but the wide variety of raw materials is more typical of Late Neolithic assemblages in the eastern Carpathian Basin (Kaczanowska et al. 2009:130).

Like the Bikeri assemblages, the Polgár-Bosnyákdomb assemblage is dominated by flakes (44.5 percent), followed by blades (26.5 percent). Cores comprise 4.5 percent of the assemblage. Endscrapers dominate the formal tool types from Polgár-Bosnyákdomb, making up 47–63 percent of all tools. By contrast, the Bikeri assemblages are more indicative of ad hoc, expedient tool kits. This is almost certainly influenced by the severely reduced nature of the Bikeri assemblages—a response to the overall scarcity of lithic raw materials at the sites.

Conclusions

The dramatic reduction in the amount of chipped stone on Early Copper Age settlement sites cannot be overemphasized. As we discussed above, our surface collections at the nearby Late Neolithic Tisza site of Szeghalom-Kovácshalom yielded more than 1,200 chipped stone artifacts, whereas years of excavations at the Bikeri sites recovered fewer than 400 artifacts. Surface collections and excavations at other Early Copper Age sites in the Körös region yielded similarly small amounts of chipped stone (Gyucha 2015; Parkinson 2006a).

The lack of systematically excavated Early Copper Age settlements makes it difficult to determine whether this drop in chipped stone occurred elsewhere on the Great Hungarian Plain, but the general trend seems to hold in most cases. As Gyucha summarized (2015:268–270), the size of chipped stone assemblages from Late Neolithic sites regularly numbers in the thousands (e.g., Polgár-Csőszhalom, n = 11,200; Öcsöd-Kováshalom, n = 2,298).

The reorganization and disruption of the extensive Neolithic long-distance trade networks seem to have occurred throughout the Great Hungarian Plain. It remains unclear the extent to which the reduction of lithic raw materials on Early Copper Age settlement sites, coinciding with the dissolution of the Neolithic tell-based settlement networks, was a result of the breakdown of these local systems of distribution or whether the breakdown of those local systems was a result of the dissolution of the broader, interregional trade network. We suspect both factors together contributed to the resulting decrease in materials during the Copper Age.

Finally, the similarities between the lithic assemblages from the neighboring sites of Vésztő-Bikeri and Körösladány-Bikeri are striking, and they reinforce patterns also exhibited in other material types (for example, in the ceramics and fauna; see Chapters 9 and 14, this volume). These similarities lead us to conclude that a single Tiszapolgár community inhabited both sites sequentially. Given the chronological overlap and sequential habitation of the two sites (see Chapter 8, this volume), the subtle differences between the assemblages likely can be attributed to intergenerational diachronic patterns throughout the Early Copper Age. Thus the assemblages from these sites provide a unique opportunity to investigate the impacts of the transition to the Copper Age at the local level.

Chapter 13

Other Small Finds

Attila Gyucha and István Oláh

In this chapter, the clay, metal, and ground and polished stone small finds are described and discussed. Other than ceramics and chipped stone objects (see Chapters 9 and 12, this volume), clay and ground and polished stone objects constitute the majority of small finds at Vésztő-Bikeri and Körösladány-Bikeri. At Vésztő-Bikeri, due to the large cache of arrowheads recovered in Block 2 (see Chapter 11, this volume), bone and antler tools (n = 256) outnumber even the chipped stone objects (n = 241). Among the other small finds, clay and stone objects far outnumber metal objects at both sites (Table 13.1). We restrict our discussion here to those finds that were discovered in secure Early Copper Age contexts; artifacts clearly associated with later archaeological periods and modern objects have been omitted. These include the harness, personal adornments, and arrowheads associated with the two Hungarian Conquest period (ninth to tenth century AD) burials at Vésztő-Bikeri (see Chapter 16, this volume). From Körösladány-Bikeri, two iron fibulae, an iron bracket, a bovid bone ice skate, and a spindle whorl recovered from Sarmatian (second to fourth century AD) features also were excluded from this analysis (see Chapter 7, this volume).

Clay Artifacts

Spindle Whorls and Perforated Ceramic Discs

There are 34 Early Copper Age small finds made of baked clay in the assemblage from Vésztő-Bikeri and 15 from Körösladány-Bikeri (Table 13.1). At Vésztő-Bikeri, the majority of clay small finds (n = 12; 35.3 percent) were identified as spindle whorls or perforated ceramic discs that presumably functioned as spindle whorls, but only a few of these artifact types were found at Körösladány-Bikeri (n = 3; 20 percent). The finds from Vésztő-Bikeri include two formal spindle whorls; the other 10 objects are perforated ceramic sherds that were reshaped into discs. The two spindle whorls from this site have a biconical shape (Figure 13.1A–B), while the single example from Körösladány-Bikeri has a globular shape (Figure 13.1C). These objects measure 3–4 cm in diameter. The perforated ceramic discs are circular in shape, 3–5 cm in diameter, with rounded, smoothed edges (Figure 13.2A–C). Three of the perforated ceramic discs from Vésztő-Bikeri and both from Körösladány-Bikeri were only partially drilled and appear to be unfinished (Figure 13.2D–F).

At Vésztő-Bikeri, most of the spindle whorls and perforated ceramic discs were found in the central part of the settlement and were associated with the longhouse structures of Features 4/14 and 5 in Blocks 2 and 3 (see Chapter 7, this volume); only two similar objects were discovered away from the longhouses, near the periphery of the village. All three objects from Körösladány-Bikeri were recovered in the fill of a well at the western edge of the village (Feature 48; see Chapter 7, this volume).

Table 13.1. Other clay, metal, and stone small finds at Vésztő-Bikeri and Körösladány-Bikeri

Raw Material	Type	Vésztő-Bikeri	Körösladány-Bikeri	Total
Clay	spindle whorl	2	2	4
	perforated ceramic disc	10	1	11
	loom weight	9	7	16
	disc	9	1	10
	ball	2	0	2
	human representation	1	2	3
Metal	copper ring	2	1	3
	copper awl	1	1	2
	other copper	1	0	1
	gold	1	0	1
Stone	whetstone	3	3	6
	hammerstone	0	1	1
	grinding stone	105	46	151
	polished stone	5	4	9
	worked pebble	15	7	22
	other stone	65	39	104
Total		**231**	**115**	**346**

Table by Attila Gyucha.

Loom Weights

Nine ceramic small finds from Vésztő-Bikeri and seven from Körösladány-Bikeri are loom weights (Table 13.1). The most common type, represented by three examples from Vésztő-Bikeri and one from Körösladány-Bikeri, has an ovate shape with a flattened or rounded bottom and a circular or oval perforation near the narrower end (Figure 13.3). These loom weights measure 9–12 cm in length and 7–9 cm in width, and the diameter of the perforations ranges between 1.3 and 1.6 cm.

A unique loom weight from Vésztő-Bikeri with an elongated body, rectangular in cross-section, has small legs at its four corners. This perforated artifact appears to be an animal effigy (Figure 13.4). In contrast to the other loom weights recovered from the Bikeri sites, which have rough surfaces similar to burned daub fragments, the exterior of this loom weight is smoothed and burnished.

At Vésztő-Bikeri, the vast majority of loom weights were found in the central part of the site, in or near the central longhouses, but at Körösladány-Bikeri, they were distributed evenly across the site. The three spindle whorls and five loom weights from the Feature 5 longhouse in Block 3 at Vésztő-Bikeri indicate that it may have been a household that specialized, if only part-time, in textile production (Parkinson et al. 2004b).

Clay spindle whorls and loom weights are often found at Neolithic and Copper Age settlements on the Great Hungarian Plain and in adjacent regions (e.g., Dombay 1960:Table XIII:2, 11, 14; McPherron et al. 1988:337; Patay 2005:Tables 52–53; Radu 2002:Figure 17:5–9; Tringham and Stevanović 1990:Figures 10.3 and 10.9). Although these artifacts rarely have been recovered from Tiszapolgár settlement contexts (Bognár-Kutzián 1972:135; Iercoşan 2002:145), the Vésztő-Bikeri assemblage and a cluster of loom weights found in a house at the contemporaneous Battonya-Vertán site in the Maros Valley (Goldman and Szénászky 2012:216) indicate that household-level textile production was common on the Great Hungarian Plain during the Early Copper Age. Flax remains were not found at the Bikeri sites (see Chapter 15, this volume), and it remains unclear whether plant or animal fibers were used to produce textiles.

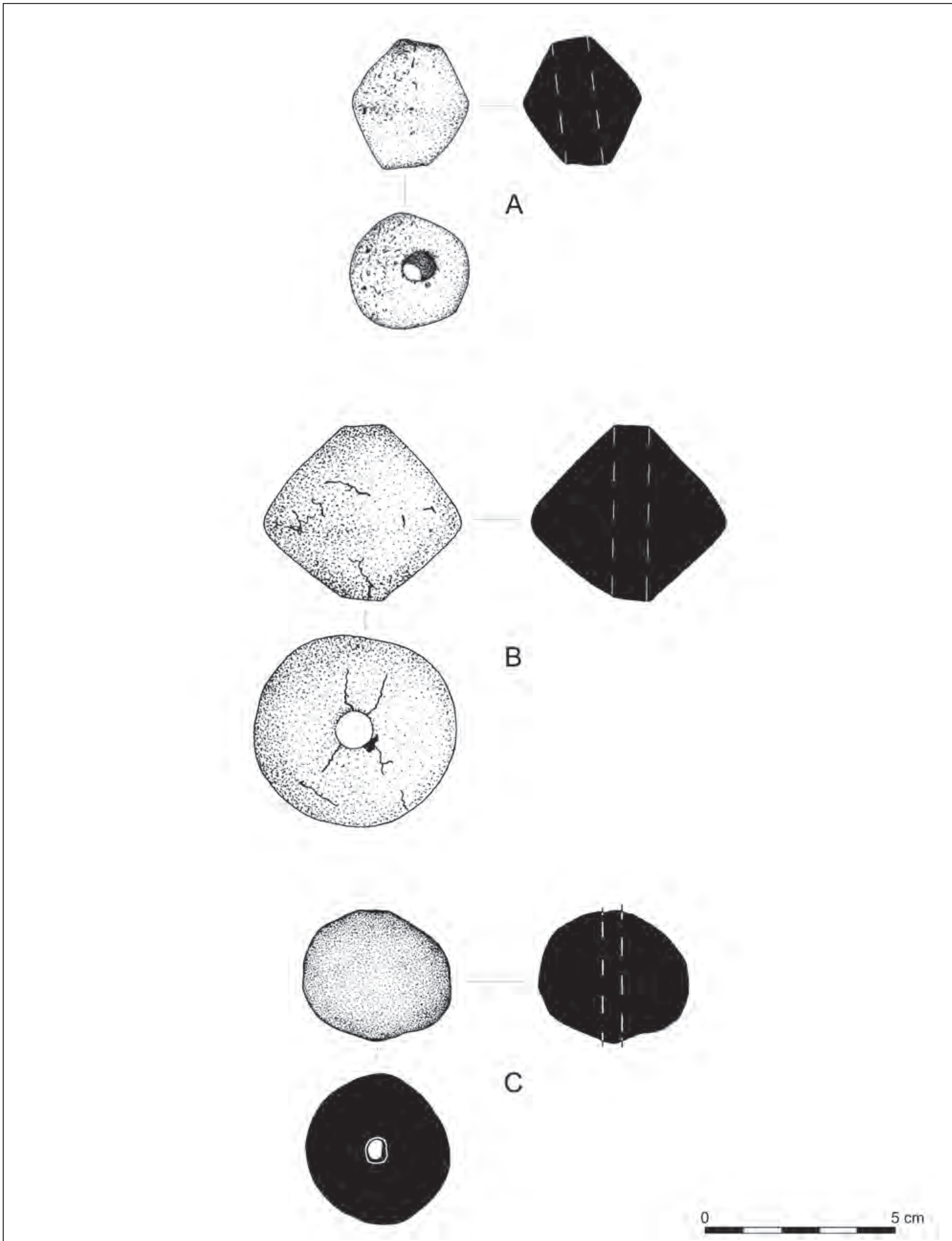


Figure 13.1. Spindle whorls from Vésztő-Bikeri (A–B) and Körösladány-Bikeri (C). A: V20SF535; B: V20SF074; C: K14SF159. *Figure by Dorottya Kékegyi.*

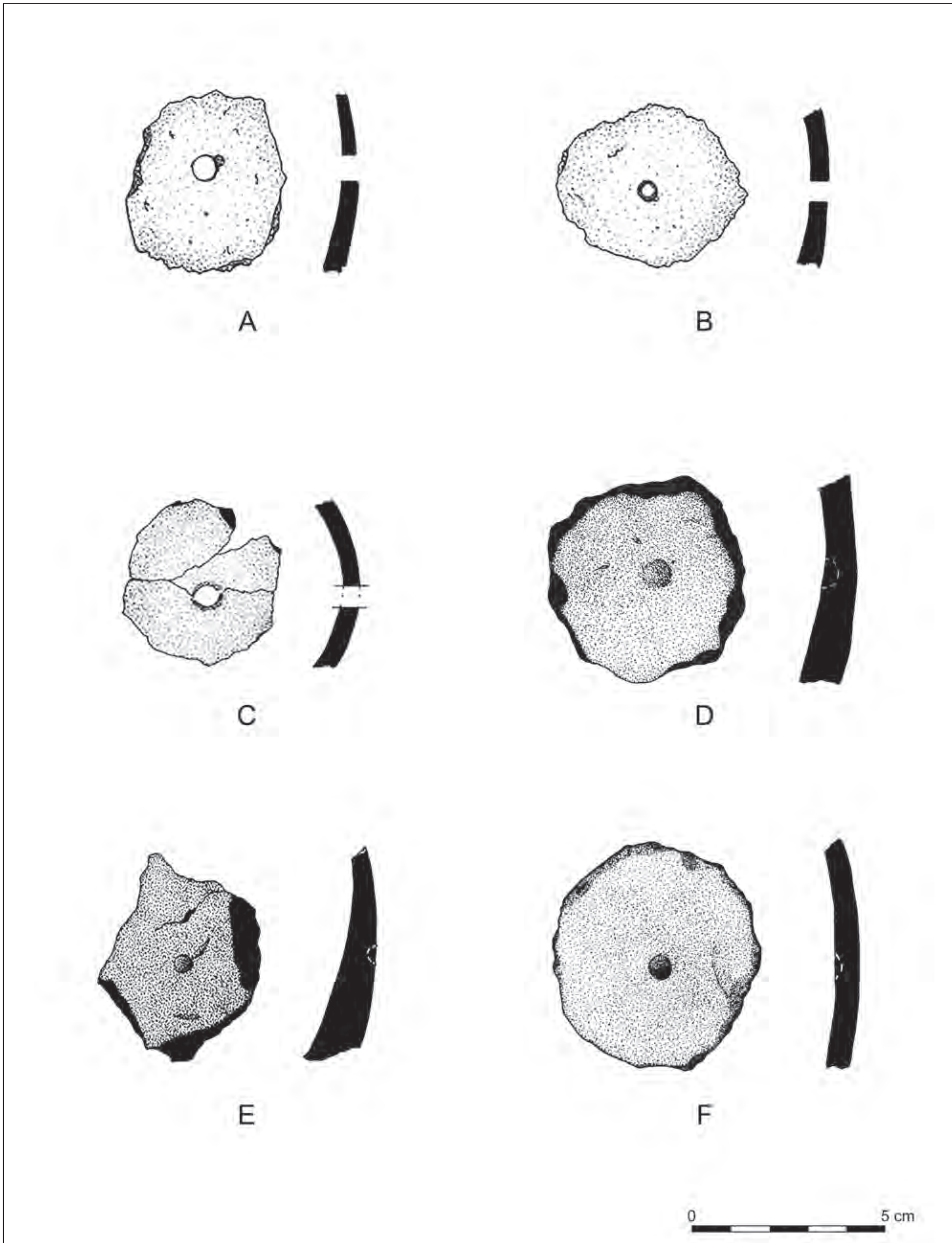


Figure 13.2. Perforated (A–C) and unfinished perforated ceramic discs (D–F) from Vésztő-Bikeri (A–D) and Körösladány-Bikeri (E–F). A: V20SF095; B: V20SF115; C: V20SF546; D: V20SF541; E: K14SF311; F: K14SF310. *Figure by Dorottya Kékegyi.*

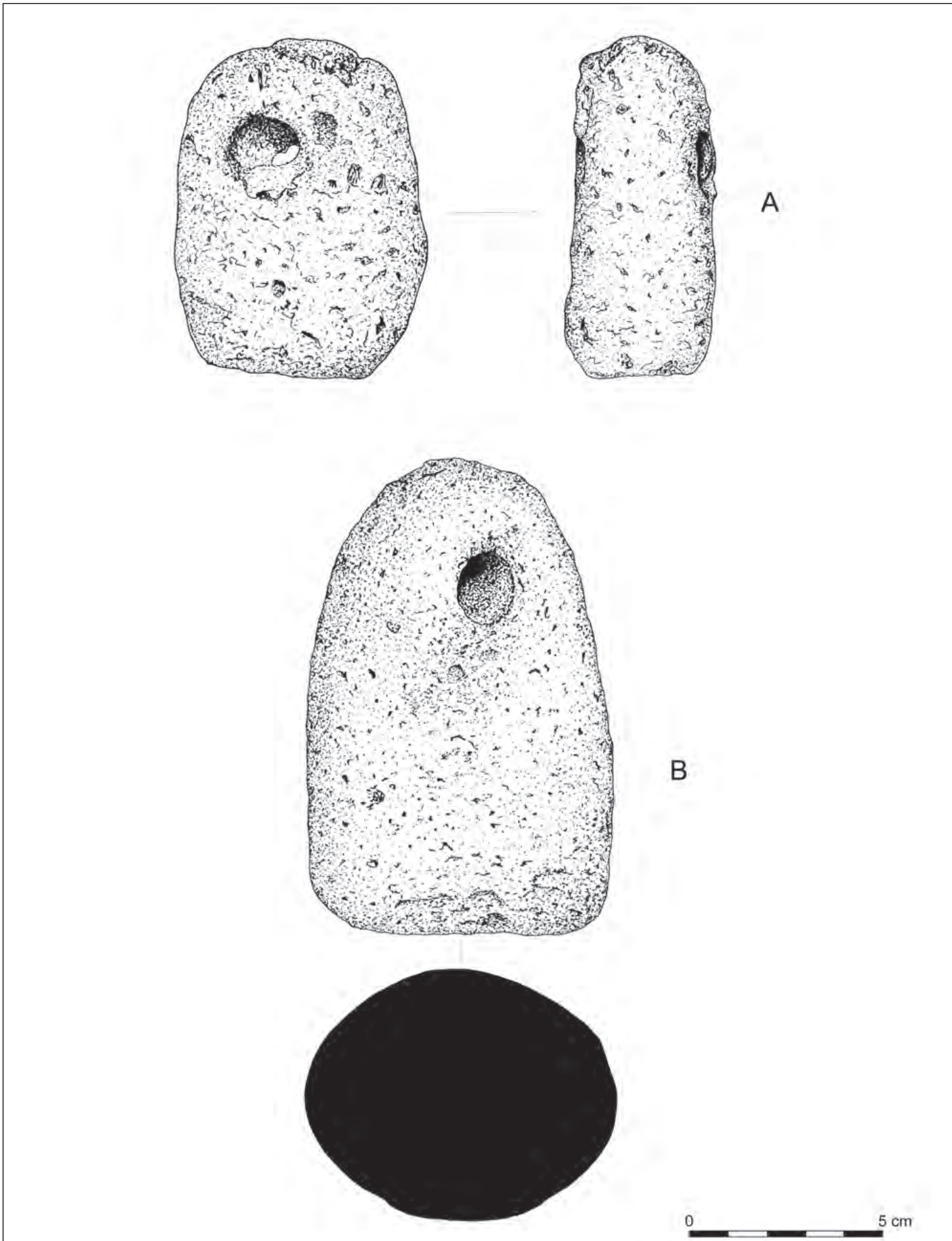


Figure 13.3. Loom weights from Vésztő-Bikeri. A: V20SF072; B: V20SF257. *Figure by Dorottya Kékegyi.*

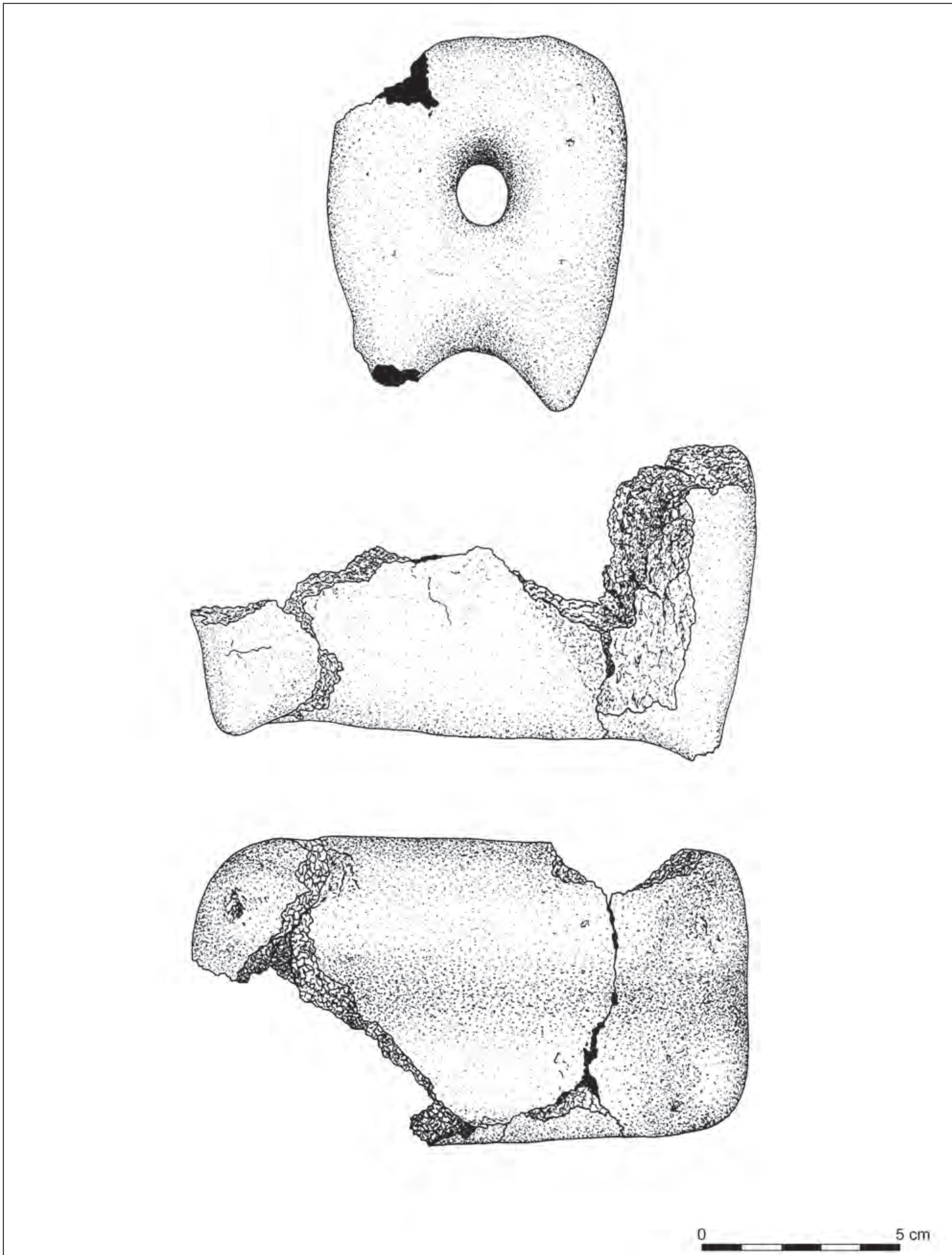


Figure 13.4. Zoomorphic loom weight from Vésztő-Bikeri. V20SF091. *Figure by Dorottya Kékegyi.*

Ceramic Discs and Balls

Ten unperforated ceramic discs were recovered at the two sites (Table 13.1; Figure 13.5). These undecorated artifacts were fairly common in the ceramic small finds assemblage of Vésztő-Bikeri (n = 9), but only a single piece was identified at Körösladány-Bikeri. While the majority measure 1.5 to 2.5 cm in diameter, two artifacts are significantly larger (Figure 13.5A–B). One disc has reed or mat impressions on its surface (Figure 13.5C), and a fingerprint is visible on another object. All the ceramic discs from Vésztő-Bikeri were found in the center of the site, near the longhouses.

This object type is not known from sites dating to other prehistoric periods on the Great Hungarian Plain. The only similar object, decorated with fingernail impressions, was found at the Tiszapolgár settlement of Tiszaug-Kisrétpart (Szabó 1934:Figure 48). The function of the ceramic discs is ambiguous. Because these artifacts seem to have been produced deliberately, and because they were found without exception in the central, residential zone of the Vésztő-Bikeri site, it is possible that they served as tokens.

A small ball, 1.6–1.9 cm in diameter, made of fired clay was recovered from the daub layer above the floor of the Feature 4/14 longhouse at Vésztő-Bikeri. Another globular fired clay artifact from this site is larger. It measures 2.9–3.2 cm in diameter and has a smoothed surface (Figure 13.6A).

Human Representations

Although intact human figurines were not recovered from the Bikeri sites, two fragmented ceramic objects that may have come from clay models were found at Körösladány-Bikeri. One of them may have been part of the leg of a figurine, while the other might be interpreted as a schematic human representation. Dotted decoration is visible on the latter item (Figure 13.6B). Objects similar to this artifact were found in several Late Neolithic Tisza contexts on the Great Hungarian Plain, such as at the Hódmezővásárhely-Gorzsa tell, where they might have been decorative elements on the rim of an altar (Horváth 2000:362). Flat figurines also have been found at Öcsöd-Kováshalom and Szegvár-Tűzköves (Korek 1987:Figures 17 and 25–26; Raczky 1987:Figures 36 and 41).

At Vésztő-Bikeri, a phallic-shaped artifact, roughly 15 cm long and 7–10 cm wide, was unearthed in the central area of the village, in a pit (Feature 98) in Block 9 (Figure 13.7). Though its texture and surface are quite rough, the artifact cannot be interpreted as a piece of construction daub, and multiple fired clay layers suggest periodic repair or renewal (for a comparable Early Neolithic example, see Kreiter et al. 2014). The object was perforated longitudinally from its flat base.

Human and animal representations in various forms (for example, figurines, face pots, painted and plastic motifs) were common throughout the Neolithic on the Great Hungarian Plain and beyond. However, they are conspicuously absent from Tiszapolgár assemblages, suggesting that fundamental transformations occurred in ritual life and religious traditions between the Neolithic and the Copper Age.

Metal Objects

Prior to the investigations of the Körös Regional Archaeological Project at the Bikeri villages, copper artifacts had not been found in Early Copper Age settlement contexts on the Great Hungarian Plain. During our excavations, four copper objects were recovered from Vésztő-Bikeri and two from Körösladány-Bikeri (Table 13.1). The size and structure of the artifacts imply that they might have been cold-hammered from prills of native copper.

A spiral ring measuring 1.5 cm in diameter was found near the Feature 5 longhouse in Block 3 at Vésztő-Bikeri (Figure 13.8A). Another copper ring—3.4–3.8 mm in diameter, ovate in cross-section, with overlapping ends—was recovered from the Feature 48 well at Körösladány-Bikeri (Figure 13.8B). A folded, narrow copper plate with narrowing ends—which might have been another ring—was found in the cultural layer above the Feature 15 longhouse in Block 9 at Vésztő-Bikeri (see Chapter 7, this volume). This artifact is decorated with curved, parallel channels (Figure 13.8C). Copper rings similar to the artifacts from the Bikeri sites have been published from Late Neolithic settlements and graves, as well as from Early Copper Age burials on the Great Hungarian Plain (e.g., Bognár-Kutzián 1972:Table XXXII; Kalicz and Raczky 1987b:122).

A single copper awl—round in cross-section and pointed at both ends—was found at each site. The 5.2 cm–long specimen from Vésztő-Bikeri was associated with the Feature 5 longhouse in Block 3 (Figure 13.8D). The artifact from Körösladány-Bikeri measures 2.3 cm in length and was recovered from the Early Copper Age cultural layer in Block 4, at the center of the settlement (Figure 13.8E). In addition, a small perforated plate fragment—found in the cultural layer above the Feature 4/14 longhouse—also is part of the Vésztő-Bikeri assemblage (Figure 13.8F).

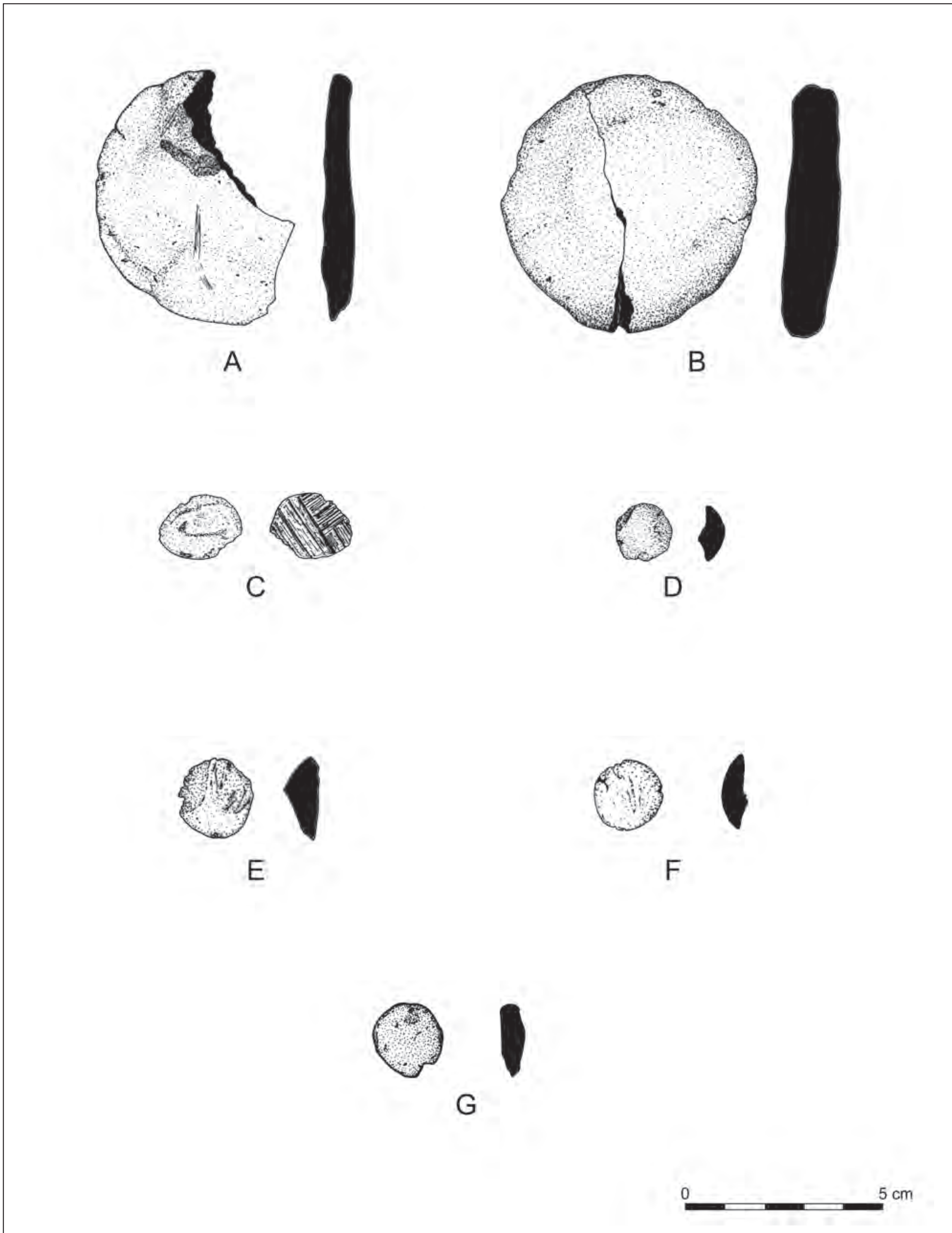


Figure 13.5. Unperforated ceramic discs from Vésztő-Bikeri (A–F) and Körösladány-Bikeri (G). A: V20SF543; B: V20SF543; C: V20SF562; D: V20SF564; E: V20SF513; F: V20SF520; G: K14SF108. *Figure by Dorottya Kékegyi.*

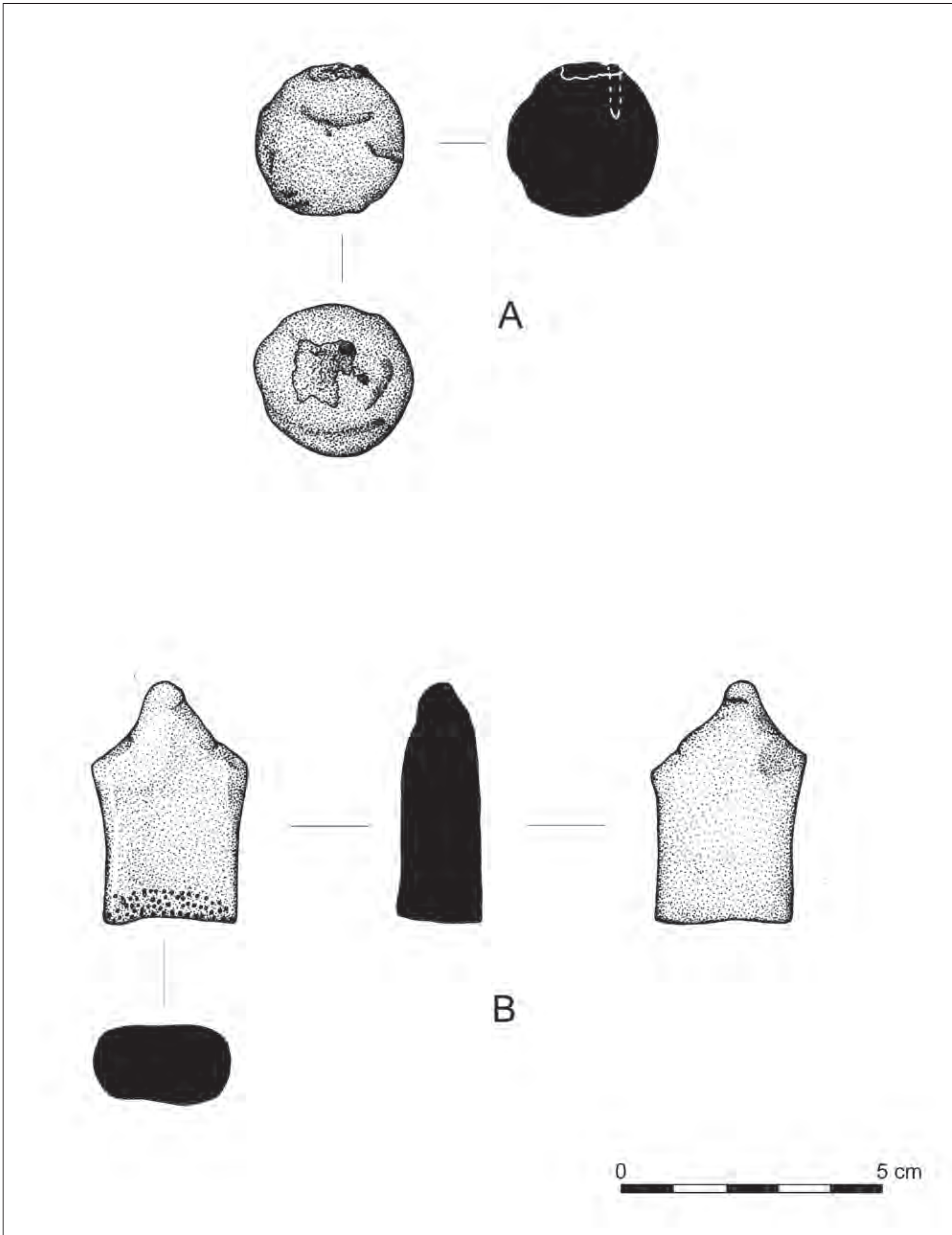


Figure 13.6. A fired clay ball from Vésztő-Bikeri (A) and a possible human representation in fired clay from Körösladány-Bikeri (B). A: V20SF517; B: K14SF153. *Figure by Dorottya Kékegyi.*

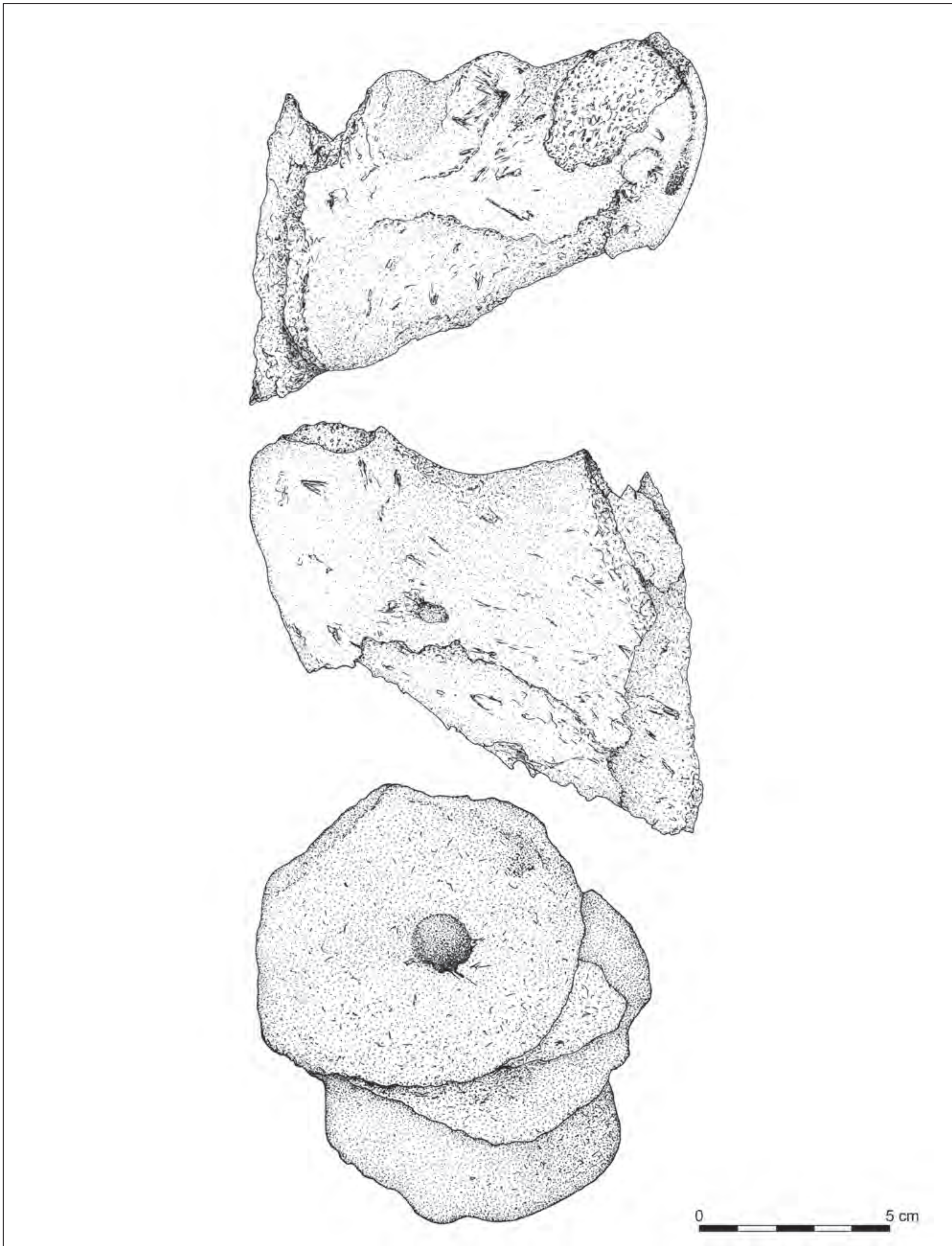


Figure 13.7. Phallic-shaped fired clay artifact with multiple layers from Vésztő-Bikeri. V20SF560. *Figure by Dorottya Kékegyi.*

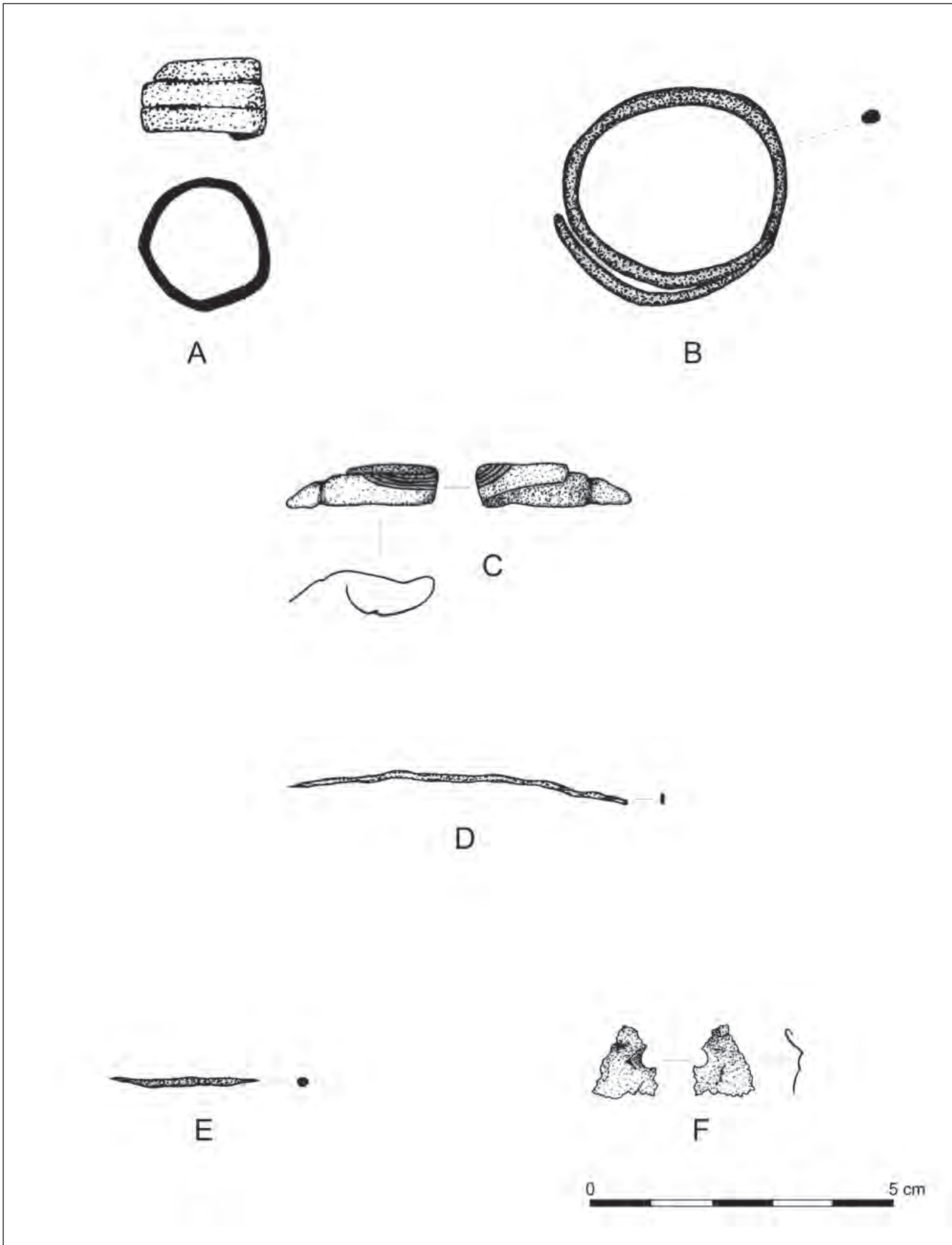


Figure 13.8. Copper artifacts from Vésztő-Bikeri (A, C, D, F) and Körösladány-Bikeri (B, E). A: V20SF089; B: K14SF297; C: V20SF542; D: V20SF228; E: K14SF112; F: V20SF227. *Figure by Dorottya Kékegyi.*

The only object made of gold from the Bikeri sites is a tiny shapeless plate that was also unearthed in the cultural layer that covered the Feature 4/14 longhouse in Block 2 at Vésztő-Bikeri. This piece, which was found in the heavy fraction from a sediment flotation sample, is the first gold object recovered from a Tiszapolgár settlement.

Jewelry and other small objects made of copper have been found at Late Neolithic settlements and graves on the Great Hungarian Plain and in neighboring regions (Borić 2009; Kalicz 1992; Siklósi 2013; Siklósi et al. 2015), but similar artifacts have not been discovered at any contemporaneous sites in the Körös region. In the Early Copper Age, the Great Hungarian Plain was part of the Carpathian–Balkan metallurgical sphere, which was characterized by heavy, uniformly made copper objects (Chernykh 1992; Hansen 2013; Kienlin 2008; Renfrew 1969). Tiszapolgár sites located closer to the Carpathian Mountains, particularly the cemeteries in northern Hungary and eastern Slovakia (Bognár-Kutzián 1963, 1972; Šiška 1964; Vizdal 1977), yielded a remarkable number of copper artifacts. By contrast, only a few specimens have been recovered at sites located in the central Plain (Gyucha 2015). This is certainly the case in the Körös region. In addition to the handful of artifacts at the Bikeri sites, only a few copper items were found in the Early Copper Age burials at the Vésztő-Mágor tell (Hegedűs 1977). The scarcity of metal objects from Early Copper Age sites in the Körös region—and the central portion of the Great Hungarian Plain—implies that the metal might have been less accessible to those Early Copper Age communities living farther from the copper sources in the Apuseni Mountains, the northern Carpathians, or the northern Balkans (Gyucha and Parkinson 2013). By the Middle Copper Age, however, heavy copper objects commonly occurred across the entire Great Hungarian Plain (Heeb 2014; Kienlin 2008; Patay 1984). This was the first time they appeared in substantial quantities in the Körös region as well.

Ground and Polished Stone Artifacts

The Bikeri sites are located about 100 km from the nearest primary sources of stone in the foothills of the Carpathian Mountains. Consequently, all the stone objects in the lower Körös Basin were acquired through long-distance exchange or direct exploitation. Due to the lack of local raw materials, the lithic assemblages from both sites were heavily curated and reduced to the point of exhaustion. As a result, it sometimes is difficult to determine whether a ground stone fragment was part of a saddle quern or a hand stone. Thus, they are included here as grinding stones.

During the excavations at Vésztő-Bikeri, 193 stone artifacts were recovered (Table 13.1). Of these, 128 could be assigned to specific tool classes. One hundred eight specimens are ground stone implements. Of these, 105 are fragments of saddle querns or hand stones (indicated as grinding stones in Table 13.1; see Figure 13.9), and three are whetstones (Figure 13.10). Polished stone tools are represented by fragments of three shaft-hole axes (Figure 13.11A), one chisel, and one unidentified object. There are also 15 worked pebbles classified as polishers or abraders in the Vésztő-Bikeri assemblage.

At Körösladány-Bikeri, 100 stone artifacts were recovered from systematic surface collections and excavations (Table 13.1); 61 of these were identified as tools. Fifty are fragments of ground stone implements. Fragments of querns and hand stones (n = 46) are followed by whetstones (n = 3) and a single hammerstone (Figure 13.12). Of the polished stone tools, there are four celts in this assemblage (Figure 13.11B–D). Seven worn pebbles were classified as polishers or abraders.

At Vésztő-Bikeri, 94 percent of the stone implements were found in the central part of the village, in Blocks 2, 3, and 9, and only 6 percent were recovered near the peripheries, in Blocks 7 and 8. By contrast, at Körösladány-Bikeri, the spatial distribution of stone artifacts was fairly even. These patterns coincide remarkably well with the faunal and floral data (see Chapters 14 and 15, this volume) as well as the distribution of bone tools (see Chapter 11, this volume) within the Bikeri sites. Thus, these tools seem to be associated with regular household activities.

Similar types of stone tools were found at both villages, and their sources were nearly identical as well (Figure 13.13). Macroscopic examination and petrographic analysis of 15 samples from Vésztő-Bikeri and 12 from Körösladány-Bikeri indicate that the bulk of the stone came from the Apuseni Mountains in western Romania. In both assemblages, the hard and abrasion-resistant sandstones from that region, which are particularly suitable for grinding stones, prevail. Other metamorphic rocks, such as gneiss, metasandstone, and phyllite, as well as granite, also are present, albeit in smaller quantities. By contrast, materials less likely to be transported by river, such as softer sandstones and limestones, are absent in the Bikeri assemblages. This suggests that the stone materials found at these Early Copper Age sites may not have been exploited directly from the geological sources in the distant outcrops of the mountains. Instead, materials transported by the Körös Rivers could have been collected from the riverbeds and on the floodplain of the lower Körös Valley, closer to the Vésztő-Bikeri and Körösladány-Bikeri sites.

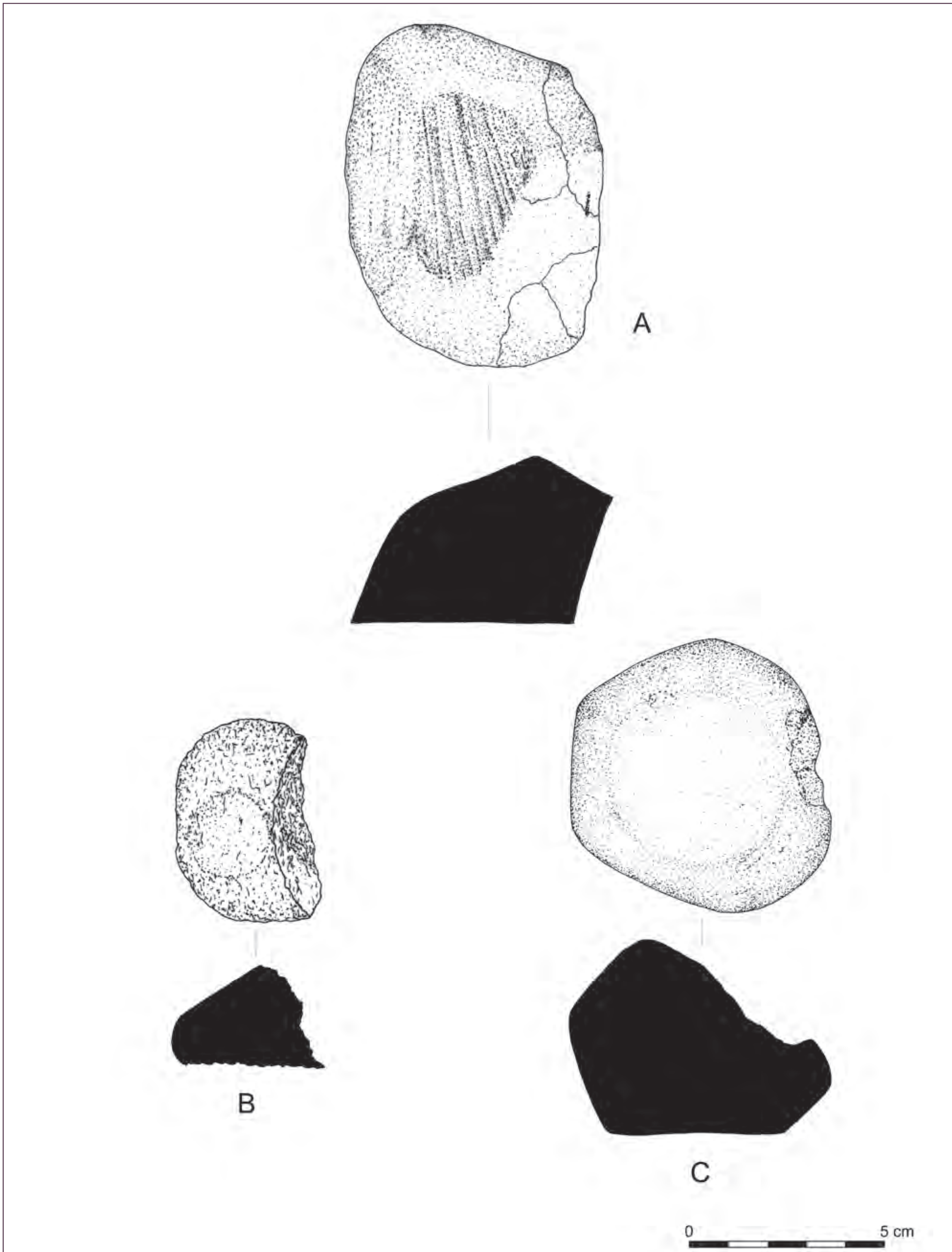


Figure 13.9. Grinding stones from Vésztő-Bikeri. A: V20SF208; B: V20SF221; C: V20SF029. *Figure by Dorottya Kékegyi.*

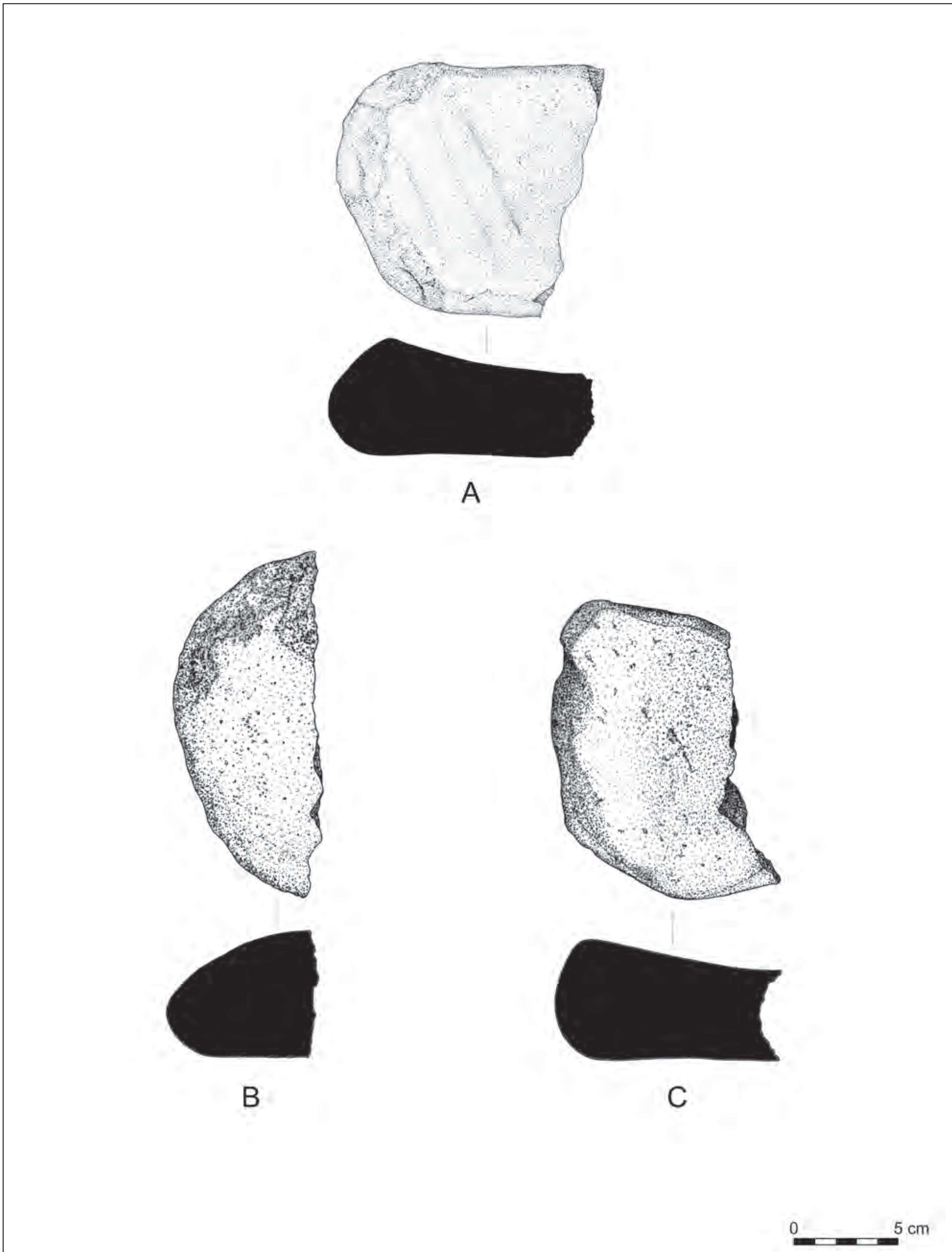


Figure 13.10. Grinding stones from Vésztő-Bikeri. A: V20SF117; B: V20SF465; C: V20SF493. *Figure by Dorottya Kékegyi.*

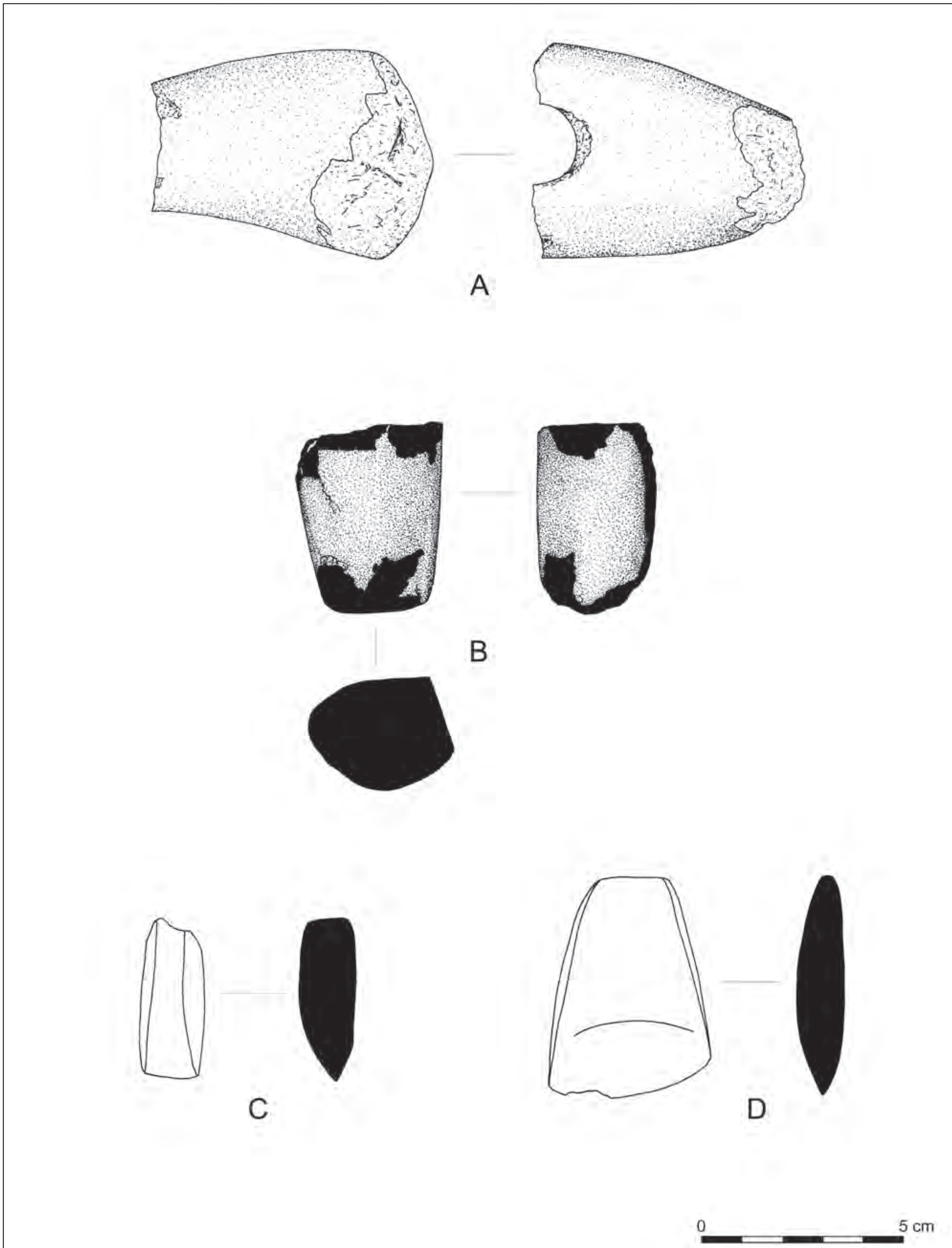


Figure 13.11. Polished stone tools from Vésztő-Bikeri (A) and Körösladány-Bikeri (B–D). A: V20SF027; B: K14SF170; C: K14SF171; D: K14SF173. *Figure by Dorottya Kékegyi.*

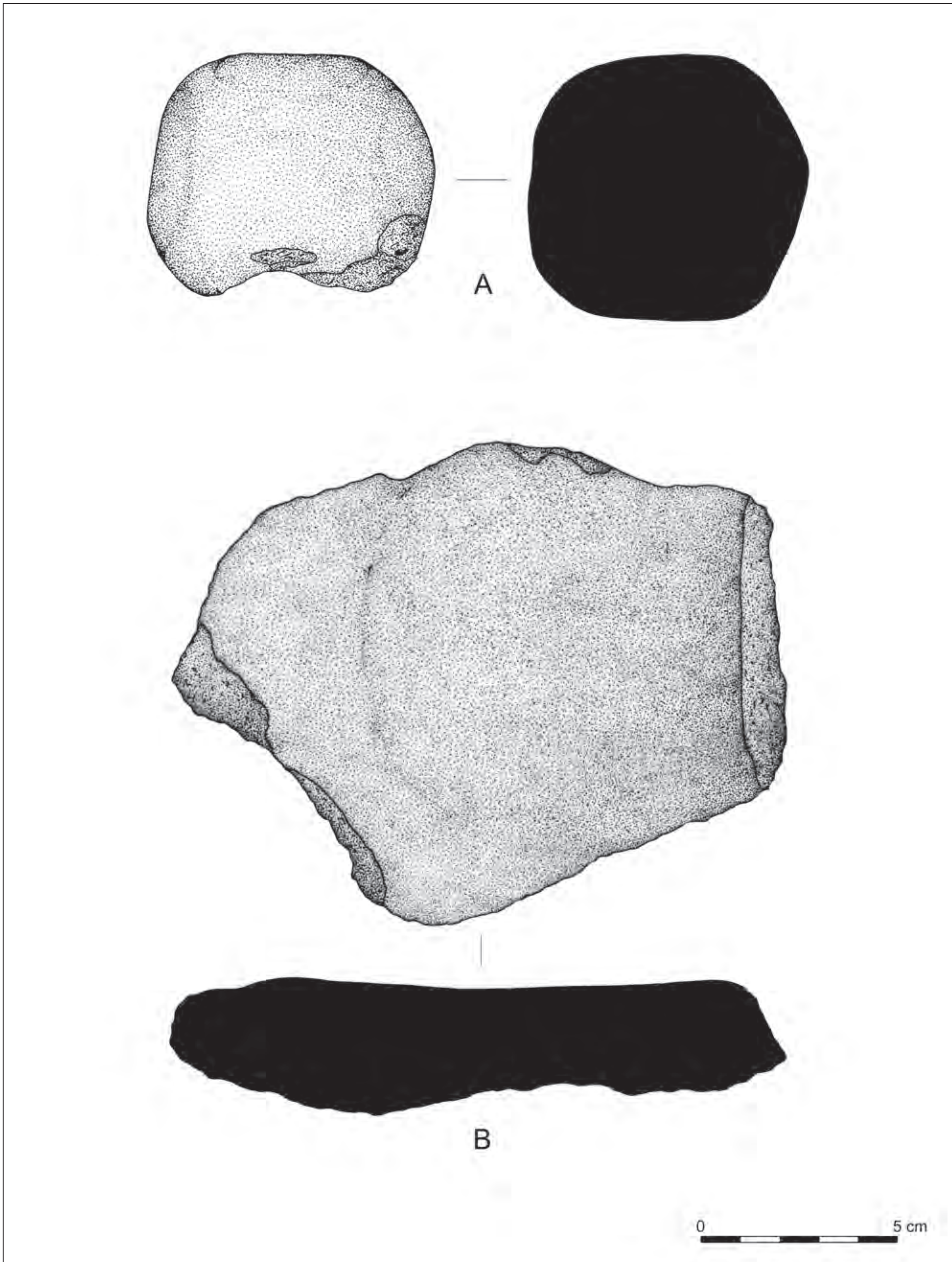


Figure 13.12. Grinding stone fragments from Körösladány-Bikeri. A: K14SF044; B: K14SF076. *Figure by Dorottya Kékegyi.*

Volcanic rocks, such as dacites and riolites, originate most likely from the Apuseni Mountains, but they also could have come from the Tokaj Mountains in northern Hungary. The basalt, basaltic andesite, andesite, dolerite, metadolerite, and other metamorphosed basaltic rocks—the best material types for ground stone implements—could have come from different locations in the Apuseni Mountains. However, some of the rare examples of basalt and basaltic andesite may have been obtained from sources in Transdanubia, specifically the area north of Lake Balaton, and also the Mecsek Mountains. The small amount of limestone and marl in the assemblages, as well as fine-grained clastic sedimentary rocks, may have derived from the Bihar Mountains or the Királyerdő Plateau.

The raw materials from Vésztő-Bikeri and Körösladány-Bikeri indicate a clear preference for sources located in the Apuseni Mountains of western Romania, at the headwaters of the Körös River branches. Most of the stones in the assemblages may have been transported naturally to locations closer to the study area by those rivers. The nearest riverbeds and terraces containing water-transported rocks are about 50–60 km northeast of the Bikeri villages. Members of the two Early Copper Age communities could have traveled to these fluvial deposits and gathered the stones themselves or obtained them through exchange.

The sources of stone materials found at the Bikeri settlements are significantly different than those at Late Neolithic sites on the southern part of the Great Hungarian Plain. At Öcsöd-Kováshalom, a Late Neolithic (early Tisza culture) site in the westernmost edge of the Körös River region, the majority of imported raw materials were from Transdanubia and northern Hungary. While small numbers of Transylvanian rocks also were used during the earlier occupation of the site, they fell out altogether during the later phase (Kaczanowska et al. 2009:133–34).

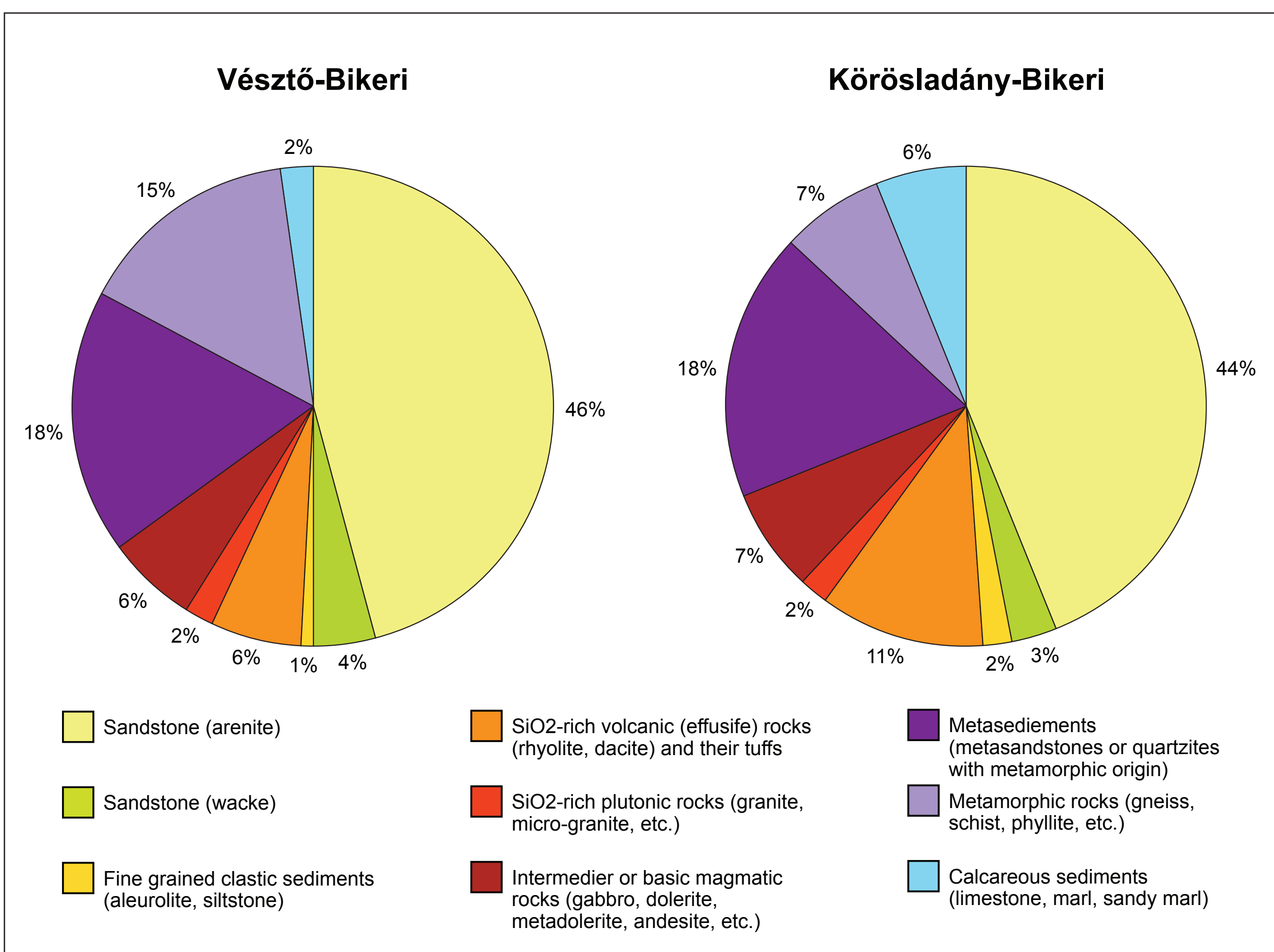


Figure 13.13. Relative frequency of raw materials used for grinding stones at Vésztő-Bikeri and Körösladány-Bikeri. *Figure by István Oláh.*

At the Late Neolithic (Tisza culture) Hódmezővásárhely-Gorzsa tell, located at the confluence of the Tisza and Maros Rivers, preliminary archaeometric investigations of ground and polished stone artifacts suggested extensive interaction with numerous neighboring and remote areas, following a pattern indicated by the ceramic and chipped stone assemblages (Horváth 2005; Starnini et al. 2007). The majority of lithic raw materials at Hódmezővásárhely-Gorzsa derived from the Sava–Vardar zone of the northwestern Balkans, the Mecsek Mountains of southeastern Transdanubia, and the Apuseni Mountains. Rocks from northern Transdanubia, the northern Carpathians, and the Subcarpathians were utilized only occasionally (Szakmány et al. 2009).

Compared to these Late Neolithic sites of the southern Great Hungarian Plain, there is considerably less variation in the sources of lithic raw materials in the Early Copper Age assemblages from Vésztő-Bikeri and Körösladány-Bikeri. This pattern in ground and polished stone tools mimics that exhibited in the chipped stone materials from these villages (see Chapter 12, this volume), as well as from other Tiszapolgár sites in the Körös region (Gyucha 2015; Gyucha and Parkinson 2013), suggesting a fundamental reorganization of exchange networks on the Great Hungarian Plain by the Early Copper Age.

Conclusions

This brief study of the small finds from the Bikeri sites reinforces many of the patterns recognized in other material assemblages from the sites. The uneven spatial distribution of artifacts associated with textile production, such as spindle whorls and loom weights, in different longhouse contexts at Vésztő-Bikeri suggests that there may have been some household-level specialization within the settlement. The overall lack of figurines from these Copper Age settlements is consistent with general trends throughout central and southeastern Europe. Similarly, the distribution of raw materials used for grinding stones at the Bikeri sites indicates a reorganization of trade networks during the transition from the Neolithic to the Copper Age. Perhaps most surprising is the lack of substantial numbers of copper artifacts or artifacts associated with copper production (such as ore, slag, crucibles, or molds) at the settlements, which suggests that the small copper objects recovered from the Bikeri sites were manufactured elsewhere and acquired through trade and exchange. Finally, the single small piece of gold indicates that the inhabitants of these villages had access to such luxury materials but most likely only occasionally and sporadically, through systems of long-distance trade and exchange.

Chapter 14

The Faunal Assemblages

Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes

Combined, the faunal assemblages from Vésztő-Bikeri and Körösladány-Bikeri constitute one of the largest systematically collected and analyzed samples from Early Copper Age settlements in southeastern Europe. The analysis of the assemblages was designed to achieve the following: (1) to reconstruct diet and economy during the Early Copper Age within the Bikeri micro-region; (2) to determine if there were any diachronic changes in these aspects within the Early Copper Age; (3) to assess the evidence for "specialized" husbandry focusing on cattle, sheep and goats, or pigs during the Early Copper Age; (4) to identify evidence for use of secondary products of domestication (for example, milk and wool; see Sherratt 1983b). The relative abundance of different species was calculated and ranked using the number of identified specimens (NISP), the minimum number of individuals (MNI), and estimated meat weights. Through these measures of abundance, the faunal assemblages from different kinds of excavated contexts were compared between the two sites.

The Copper Age occupations at the two adjacent sites overlapped but were sequential (see Chapter 8, this volume), so some diachronic changes within the Early Copper Age also were examined. The faunal assemblages are very similar in many respects, but they are influenced significantly by the nature of the archaeological contexts excavated at the two settlements. When similar archaeological contexts are compared between the two sites, the faunal assemblages are nearly identical. Additional information about Early Copper Age diet and economy can be found in studies of stable isotopes in burials and residues on ceramics (Giblin and Yerkes 2016; Hoekman-Sites and Giblin 2012; see also Chapter 10, this volume), but the results of those studies are not discussed in this chapter. The description and interpretation of excavated features mentioned in this chapter are found in Chapters 7 and 8 and Appendixes IV to VI.

Recovery and Analytical Methods

Faunal materials were hand-collected and recovered from sifted and flotation-processed samples from both Bikeri sites. During the excavations, ¼-inch mesh screens were used to recover small remains. At Vésztő-Bikeri, sediments from plowzone layers, portions of the fortification ditches (Features 17 to 22, 66, and 88), most of the Feature 15 longhouse structure, and some post-Copper Age features were not sifted (see Chapter 7, this volume). This was also true for some layers of the palisade and fortification ditches (Features 2, 8/46, and 30) and the Feature 48 well at Körösladány-Bikeri (see Chapter 7, this volume). Faunal remains from both sites were highly fragmented, with an average length of 50 mm. Many fragments could not be identified to species, only to genus or to a broader taxonomic group (such as large mammal, small bird, fish species, or unidentified vertebrate).

As noted above, identified fragments were used to calculate the relative abundance of different animals based on the NISP for each species or taxon, and the MNI. NISP and MNI were compared to check for sampling bias (Klein and Cruz-Uribe 1984:24–31), but they were found to be in agreement. MNI also was used to estimate meat weights for different species and taxonomic groups. Ranks of the contribution of different animals to the Vésztő-Bikeri diet were calculated from NISP, MNI, and meat weight, and compared.

Because antler fragments may have originated from collecting shed antler and may not represent Cervidae species that were hunted and consumed, they were not included in the totals used to calculate species abundance. The few horse remains (Equidae) were believed to be intrusive from later site activities and also were excluded from calculations.

Body part frequency for livestock was recorded, and utility values of bones from body regions—including head, trunk, meaty limbs, "dry" (less meaty) limbs, and terminal bones from the extremities (such as hooves and tails)—were estimated using an anatomical classification system developed by Kretzoi (1968; see Table 14.1:I). The head and terminal bones have lower food utility values (less meat and marrow) and usually are removed during primary butchering, although some choice parts (such as the tongue and brains) are found inside the skull. Lower dry limbs have medium food value but may have been used to make bone tools (see Chapter 11, this volume). The trunk region and meaty limbs are richer in meat and marrow. Since the average number of bones in the skeletons of domesticated animals is similar (Table 14.1:II), NISP can be used in utility calculations for livestock without any adjustments. It is assumed that rodents, dogs, snakes, frogs, toads, and land snails were not often consumed (if at all), and they and other taxonomic groups with small sample sizes were excluded from diet reconstructions and statistical evaluations.

Age profiles for domesticated animals were constructed using dental eruption and wear patterns and epiphyseal fusion (Bull and Payne 1982; Deniz and Payne 1982; Grant 1982; Greenfield and Arnold 2008; Grigson 1982; Jones 2006; Silver 1969; Wilson et al. 1982). This was done to assess evidence for different patterns of stock rearing and the use of secondary products of domestication based on the premise that if domesticates were kept for their milk, wool, hair, or traction, they would have had to reach adult age before they were killed, while animals raised just for their primary products, such as meat, marrow, and hides, would have been slaughtered when they were younger (Bogucki 1986; Craig et al. 2005; Halstead and Isaakidou 2011; Sherratt 1983b).

Table 14.1. Mammalian osteology

I. Skeletal Elements in Five Body Regions of Mammals (adapted from Kretzoi 1968)				
Head Region	**Trunk Region**	**Upper Meaty Limbs**	**Lower Dry Limbs**	**Terminal Bones**
Cranium	Vertebrae	Scapula	Carpals	Phalanges
Maxilla (incl. teeth)	Ribs	Humerus	Astragalus	Caudal vertebrae
Mandible (incl. teeth)	Sternebrae	Femur	Calcaneous	
Atlas	Pelvis	Patella	Other tarsals	
Axis	Sacrum	Radius	Metacarpal	
Hyoid		Ulna	Metatarsal	
		Tibia	Metapodial	

II. Average Number of Bones in the Skeletons of Some Domesticated Animals (adapted from Schmid 1972)						
Region	**Cattle**		**Ovicaprid**		**Pig**	
	N	**%**	**N**	**%**	**N**	**%**
Head region	51	24.9%	53	25.5%	63	24.9%
Trunk region	59	28.8%	60	28.8%	60	23.7%
Upper meaty limbs	20	9.8%	20	9.6%	22	8.7%
Lower dry limbs	32	15.6%	32	15.4%	38	15.0%
Terminal bones	43	21.0%	43	20.7%	70	27.7%
Total	**205**	**100%**	**208**	**100%**	**253**	**100%**

Table by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.

Most of the faunal remains from Vésztő-Bikeri were identified and analyzed by Amy Nicodemus (about 80 percent), and a similar portion of the remains from Körösladány-Bikeri were examined by Zsófia E. Kovács (about 75 percent). Richard W. Yerkes analyzed the rest of the faunal assemblages from the sites. Identical methods and references were employed by each analyst. Comparative faunal collections at the Eötvös Loránd University, The Ohio State University, and the University of Michigan were used in the identifications, along with standard faunal atlases and illustrated publications (Chaplin 1971; Niethammer and Krapp 1978; O'Connor 2000; Schmid 1972; Silver 1969; Sisson 1953; Ujhelyi 1994; Wilson et al. 1982). Species determination for the Caprinae subfamily (sheep or goats) followed Boessneck (1969) and Buitenhuis (1995). Wild boar remains were separated from domestic pig, and aurochs elements were distinguished from domestic cattle using the size ranges published by Bökönyi (1995).

The Vésztő-Bikeri Faunal Assemblage

Nearly 35,000 animal bone, antler, scale, and shell fragments were recovered during excavations at Vésztő-Bikeri. During our analysis, 22,480 faunal elements (about 64 percent of the total recovered) were examined (Table 14.2). Of these, 136 fragments (0.6 percent) were found in two intrusive burials from the Hungarian Conquest period (ninth to tenth century AD). Of the 22,344 specimens from Early Copper Age contexts, 6,387 tiny fragments from flotation samples (28 percent) could be identified only as vertebrates, leaving 15,957 fragments (71 percent) sorted into gross vertebrate classes of mammal (Mammalia), bony fish (Osteichthyes), bird (Aves), reptile (Reptilia), and amphibian (Amphibia), as well as into mollusk (phylum Mollusca) classes Bivalvia and Gastropoda. Excluding the 1,068 remains from rodents or insectivores, the eight snake vertebrae, the 290 amphibian bones, the 61 land snail fragments, and 65 bones from domestic dogs that probably were not eaten, there were 14,465 fragments from animals that were consumed or exploited by the Early Copper Age inhabitants of Vésztő-Bikeri. This is 91 percent of the recovered mammal, fish, bird, reptile, amphibian, and mollusk remains from the site (excluding 6,387 tiny, unidentified vertebrate fragments).

However, out of the 11,428 larger mammal bone fragments (excluding dogs, rodents, insectivores, and other micromammals) from Early Copper Age contexts at Vésztő-Bikeri, only 2,920, or 26 percent, could be assigned to a genus or species (Table 14.2). Of these, 2,797 are from domesticated mammals (96 percent), and only 123 are from wild mammals (4 percent). The total number of domestic mammals is 2,862 if dogs are included, but the proportion of domesticated mammals remains at 96 percent. Additionally, 4,591 (40 percent) of the larger mammal fragments from Vésztő-Bikeri could be grouped only by their size, and 3,917 (34 percent) were classified as indeterminate mammal. The breakdown within the mammal size groups was: large (cattle/horse/red deer/aurochs size, 4 percent), medium (pig/caprine/roe deer size, 34 percent), and small (dog/beaver/hare size, 2 percent). Only 110 (6 percent) of the 1,987 identified fish, bird, and reptile remains could be assigned to a specific genus or species, reflecting the highly fragmented condition of the smaller remains.

As indicated in Table 14.2:VIII, of the 5,957 identifiable elements from consumed or exploited species during the Early Copper Age at Vésztő-Bikeri, 2,797 (47 percent) were from domesticated mammals, 123 (2 percent) were from wild mammals, 1,824 (31 percent) were fish remains, 99 (2 percent) were from birds, 55 (1 percent) were from European pond turtles (*Emys orbicularis*), and 1,059 (18 percent) were freshwater mussels (*Unio* sp.). A total of 1,492 fragments in Early Copper Age contexts (1,512 in all contexts) came from animals that were not likely to have been consumed or exploited, including some commensal species (such as rodents) attracted to stored food. Other fragments may be from animals that burrowed into the site. There also were 93 horse (*Equus caballus*) elements in two Hungarian Conquest period burials; the other seven horse bones found in an Early Copper Age longhouse (Feature 4/14) most likely were intrusive from one of those graves. No domesticated horse remains were identified in undisturbed Early Copper Age contexts at Vésztő-Bikeri.

Overview of the Vésztő-Bikeri Faunal Assemblage

Table 14.2 lists the NISP in the Vésztő-Bikeri faunal assemblage from eight different excavation contexts. The Early Copper Age total for animals is 22,344 faunal elements from all these contexts. As noted above, only 14,465 fragments were from animals that were probably consumed or exploited. Of these, mammals make up 56 percent of the identified material (NISP = 11,428), followed by fish (13 percent; NISP = 1,824), freshwater mussels (7 percent; NISP = 1,059), birds (1 percent; NISP = 99), and turtles (less than 1 percent; NISP = 55). More meaningful are the percentages of animals represented by the 5,957 identifiable fragments listed in Table 14.2:VIII. Identifiable mammal and reptile fragments were assigned to a genus or species; others to a class (such as fish, bird, mussel). The contribution of fish to the Early Copper Age diet may be overrepresented by the numerous skeletal fragments from small species.

Table 14.2. Faunal remains from Vésztő-Bikeri

Taxon	Common Names	Number of Identified Specimens (NISP) in Early Copper Age Contexts								Total	Hungarian Conquest Period Burials	Site Total
		Longhouses	Block 4 Midden	Bell-Shaped Pit	Kilns in Well	Other Features	Palisade and Ditches	Burials	Units Outside Features			
I. Mammals												
Domestic Mammals												
Bos taurus	cattle	402	459	3	1	51	13		164	1,093		**1,093**
Ovis/Capra	sheep/goat	475	142	9	13	2	87	7	175	910	12	**922**
Ovis aries	sheep	16	16			6			4	42		**42**
Capra hircus	goat	12	8						1	21		**21**
Sus domesticus	domestic pig	330	137	4	19	18	22	3	198	731	1	**732**
Canis familiaris	domestic dog	26	3		13	14	4		5	65		**65**
Equuidae	horse family	7									93	**100**
Total Domestic Mammals		**1,261**	**765**	**16**	**46**	**91**	**126**	**10**	**547**	**2,862**	**106**	**2,968**
Wild Mammals												
Bos primigenius	aurochs	8								8		**8**
Sus scrofa	wild boar	6	11	1			2		7	27		**27**
Cervus elaphus	red deer	13(15)	7		(1)	1(1)	7		5(27)	33(44)		**33(44)**
Capreolus capreolus	roe deer	10	12(1)			2			8	32(1)		**32(1)**
Canis lupus	wolf								1	1		**1**
Lepus europaeus	brown hare	10	1	2	2		1	1	1	18		**18**
Castor fiber	beaver		1			1				2		**2**
Mustela eversmanni	steppe polecat	1							1	2		**2**
Total Wild Mammals		**48**	**32**	**3**	**2**	**4**	**10**	**1**	**23**	**123**		**123**
Indeterminate Mammals												
Bos/Equus size group	large mammal	239	43	1	9	2	12	1	201	508		**508**
Sus/Ovis/Capra/Cervus size	medium mammal	2,204	690	32	40	40	175	6	693	3,880		**3,880**
Canis/Castor/Lepus size	small mammal	142	18	6	1	3	9	1	23	203		**203**
Indeterminate fragment	unidentified mammal	3,094		35	48	43	116	9	572	3,917		**3,917**
Total Indeterminate Mammals		**5,679**	**751**	**74**	**98**	**88**	**312**	**17**	**1,489**	**8,508**		**8,508**
Total Larger Mammals		**6,988**	**1,548**	**93**	**146**	**183**	**448**	**28**	**2,059**	**11,493**	**106**	**11,599**

Table 14.2. Faunal remains from Vésztő-Bikeri *(continued)*

Taxon	Common Names	Number of Identified Specimens (NISP) in Early Copper Age Contexts								Total	Hungarian Conquest Period Burials	Site Total
		Longhouses	Block 4 Midden	Bell-Shaped Pit	Kilns in Well	Other Features	Palisade and Ditches	Burials	Units Outside Features			
Arvicolinae sp.	vole species	28			6	9	14	2	14	73	2	**75**
Apodemus sp.	wood mouse	140			3	9	6	3	1	162		**162**
Rodentia	unidentified rodent	730	3	5	21		34	10	27	830	4	**834**
Insectivores												
Talpa europaea	European mole						2			2		**2**
Insectivore sp.	insectivore family						1			1		**1**
Total Rodents and Insectivores		**898**	**3**	**5**	**30**	**18**	**57**	**15**	**42**	**1,068**	**6**	**1,074**
Total Mammals		**7,886**	**1,551**	**98**	**176**	**201**	**505**	**43**	**2,101**	**12,561**	**112**	**1,2673**
II. Fish												
Silurus glanis	wels catfish	18		3					2	23		**23**
Cyprinus carpio	common carp	2								2		**2**
Rutilus rutilus	roach	1								1		**1**
Cyprindidae sp.	carp species	7				1			1	9		**9**
Pisces	unidentified fish	1,346	9	200	24	12	171	9	18	1,789	4	**1,793**
Total Fish		**1,374**	**9**	**203**	**24**	**13**	**171**	**9**	**21**	**1,824**	**4**	**1,828**
III. Birds												
Anatidae	duck family	15	4							19	1	**20**
Falconiformes sp.	raptor species						1			1		**1**
Aves, large species	large birds	2								2		**2**
Aves, medium species	medium birds	15		8	1	2	3	1	3	33	2	**35**
Aves, small species	small birds		3			1	1			5		**5**
Aves	unidentified birds	28	1		1		2		7	39		**39**
Total Birds		**60**	**8**	**8**	**2**	**3**	**7**	**1**	**10**	**99**	**3**	**102**
IV. Reptiles												
Emys orbicularis	European pond turtle	45	1	2	1		4	1	1	55	1	**56**
Serpentes	unidentified snake	8								8		**8**
Total Reptiles		**53**	**1**	**2**	**1**	**0**	**4**	**1**	**1**	**63**	**1**	**64**

Table 14.2. Faunal remains from Vésztő-Bikeri *(continued)*

Taxon	Common Names	Number of Identified Specimens (NISP) in Early Copper Age Contexts								Total	Hungarian Conquest Period Burials	Site Total
		Longhouses	Block 4 Midden	Bell-Shaped Pit	Kilns in Well	Other Features	Palisade and Ditches	Burials	Units Outside Features			
Anura	unidentified frog/toad	156	1		24	3	20	76	10	290	14	**304**
Total Amphibians		**156**	**1**	**0**	**24**	**3**	**20**	**76**	**10**	**290**	**14**	**304**
VI. Unidentified Vertebrates		6,256		57		10	64			**6,387**		**6,387**
VII. Mollusks												
Unio sp.	freshwater clam	366	8	11	89	25	493	61	6	1059	2	**1,061**
Gastropoda sp.	land snail	20	9		2	8	18	4		61		**61**
Total Mollusks		**386**	**17**	**11**	**91**	**33**	**511**	**65**	**6**	**1,120**	**2**	**1,122**
Total Fish, Birds, Reptiles Amphibians, Mollusks, and Unidentified Vertebrates		**8,285**	**36**	**281**	**142**	**62**	**777**	**152**	**48**	**9,783**	**24**	**9,807**
Grand Total		**16,171**	**1,587**	**379**	**318**	**263**	**1,282**	**195**	**2,149**	**22,344**	**136**	**22,480**
VIII. Percentage of Selected Classes of Animals by Context at the Vésztő-Bikeri Site												
Context		**Longhouses**	**Block 4 Midden**	**Bell-Shaped Pit**	**Kilns in Well**	**Other Features**	**Palisade and Ditches**	**Copper Age Burials**	**Units Outside Features**	**Copper Age Total**	**Intrusive Burials**	**Total**
Domestic mammals		39%	93%	7%	22%	63%	15%	12%	90%	47%	91%	48%
Wild mammals		2%	4%	1%	1%	3%	1%	1%	4%	2%	0%	2%
Fish		44%	1%	84%	16%	11%	21%	11%	3%	31%	3%	30%
Birds		2%	1%	3%	1%	2%	1%	1%	2%	2%	3%	2%
Turtles		1%	<1%	1%	1%	0%	<1%	1%	<1%	1%	1%	1%
Freshwater mussels		12%	1%	5%	59%	20%	61%	73%	1%	18%	2%	17%
Total %		**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
NISP		**3,128**	**820**	**243**	**151**	**122**	**807**	**83**	**603**	**5,957**	**116**	**6,073**

Notes: Numbers of antler fragments are in parentheses and were not included in Early Copper Age totals. Antlers and horse remains not included in Early Copper Age totals. The category of "Other Features" includes Features 2, 98, 100, 126, 128, 145, 146, 149, and 150. In VIII, dogs, indeterminate mammals, rodents and insectivores, serpents, gastropods, and unidentified vertebrates were not included when calculating percentages. *Table by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.*

The remains of different animals were not distributed uniformly across the site (Table 14.2; Figure 14.1). Chi-square tests of the distribution of domesticated mammals, wild mammals, fish, birds, and mussel remains in the longhouses, the Block 4 midden, the bell-shaped pit (Feature 13), the palisade and ditches, and excavation units (EUs) outside of features at Vésztő-Bikeri show that NISP for these animals in each context was significantly different: $\chi^2 = 2975.69$, T(0.01) = 32.0, df = 16. Turtle remains were excluded, and one cell (5 percent) had a count of less than five.

This context-dependent variation is important, especially when comparing the assemblages from the two sites. For example, in Block 4, a small 2 x 2 m excavation block placed on top of a midden just inside the innermost palisade at Vésztő-Bikeri, there were significantly more domesticated and wild mammal remains than expected (domesticated: observed = 762, expected = 395; wild: observed = 23, expected = 17). Ninety-three percent of the remains in Block 4 were from domesticated mammals, and 4 percent were from wild mammals, while fish, birds, turtles, and mussels each amounted to only 1 percent or less of the total (Table 14.2). Mammal remains also were more abundant than expected in EUs located outside of features (domesticated: observed = 542, expected = 290; wild: observed = 23, expected = 13). However, in the fill of the bell-shaped pit near the longhouses (Feature 13), fish accounted for 84 percent of the NISP. This is a much higher frequency than expected (observed = 203, expected = 77). Fish remains also were abundant (44 percent of the NISP) in the longhouses. In other features, there were more mammals (domesticated: 67 percent, wild: 3 percent) and fewer fish (10 percent). Freshwater mussel shells were abundant in the Early Copper Age burials, in the kilns or ovens inside the well, and in the fill of the palisade and ditches. Some of the mollusks in the ditches may have derived from the loess subsoil that was mixed in with faunal materials when they were filled in.

As noted above, most of the identified mammal remains (not including rodents) from Early Copper Age contexts were from domesticated species (96 percent). All the southeastern European domesticates were present in the assemblage, including cattle (*Bos taurus*), sheep (*Ovis aries*), goat (*Capra hircus*), domestic pig (*Sus domesticus*), and dog (*Canis familiaris*). In the entire Early Copper Age assemblage of domestic animal remains, cattle and ovicaprines occurred in roughly equal proportions (38 percent and 34 percent, respectively), pigs were less frequent (26 percent), and domesticated dog remains accounted for only 2 percent

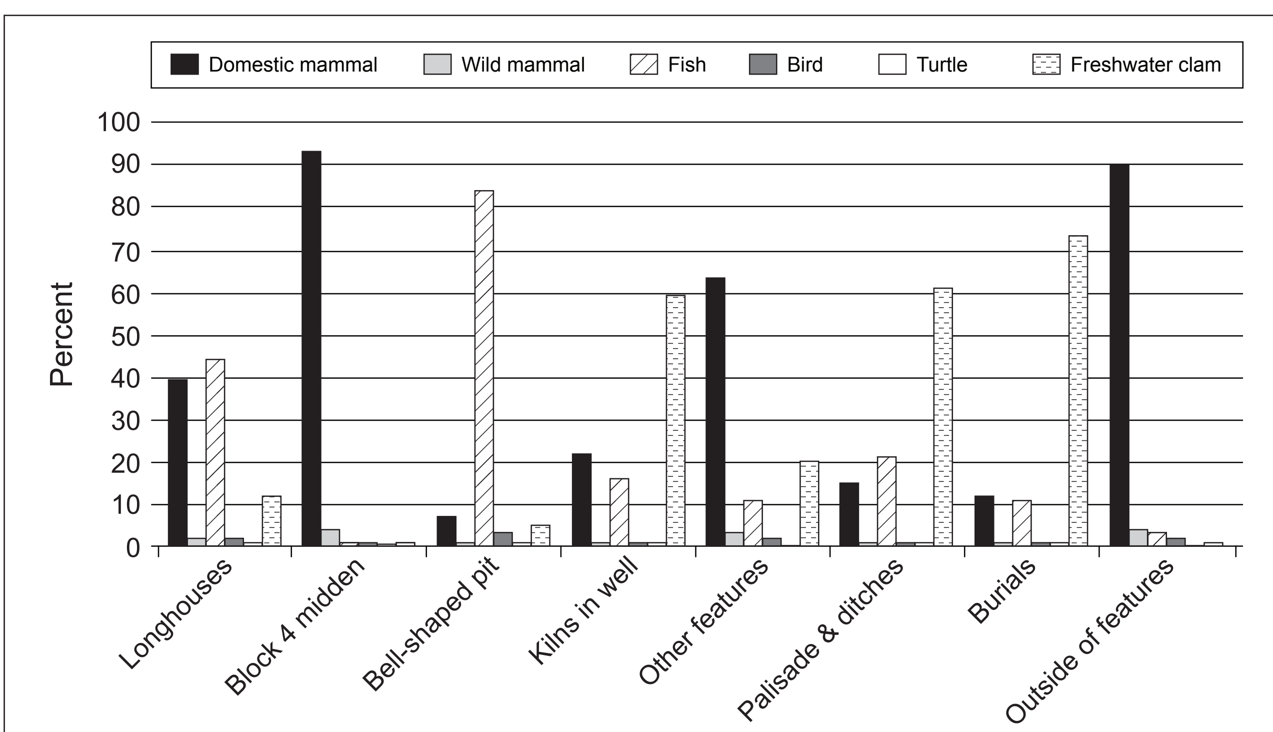


Figure 14.1. Percentage of NISP for animal taxa from Early Copper Age excavation contexts at Vésztő-Bikeri. Source: Table 14.2. *Figure by Amy Nicodemus and Richard W. Yerkes.*

of the total (Table 14.3:I; Figure 14.2). The abundance of remains of domesticated animals varied by context. A chi-square test of the distribution of remains of domesticated cattle, ovicaprines, and pigs in the longhouses, the Block 4 midden, the palisade and ditches of the enclosure, the bell-shaped pit (Feature 13), other features, and EUs outside of features at Vésztő-Bikeri showed a significant difference between these contexts: $\chi^2 = 342.68$, T(.01) = 23.21, df = 10. Two of the cells (11 percent) had counts less than five.

The frequency of cattle remains was higher than expected in the Block 4 midden, where they made up 60 percent of the total NISP, and in the other features, where 56 percent of the NISP for livestock were cattle (Table 14.3:I; Figure 14.2). Sheep/goat remains were most abundant in the fill of the palisade and ditches (69 percent), in the small sample from the bell-shaped pit of Feature 13 (56 percent), and in the longhouses (40 percent). Most domesticated animal remains found in the kilns or ovens in the filled-in well were from pigs (41 percent). Bones from cattle (30 percent), sheep or goats (33 percent), and pigs (36 percent) were more evenly distributed in the EUs outside of features, with fewer cattle remains than expected and more pig remains (Table 14.3:I; Figure 14.2).

Although far less common, a variety of wild mammal species was represented in the Vésztő-Bikeri faunal assemblage (Table 14.2). These include the four principal large game species—red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*), and aurochs (*Bos primigenius*)—as well as a number of small game and/or fur-bearing species, such as brown hare (*Lepus europaeus*), beaver (*Castor fiber*), wolf (*Canis lupus*), and a mustelid, possibly steppe polecat (*Mustela eversmanni*). Most of the wild mammal remains were found in the longhouses, in the Block 4 midden, in EUs outside of features, and in the fill of the palisade trench and fortification ditches. As noted above, the abundance of wild animals was greater than expected in the Block 4 midden and the EUs outside of features, but it was less than expected in the longhouses (observed = 48, expected = 65).

Remains of voles (*Arvicolinae* sp.), field mice (*Apodemus* sp.), and at least one insectivore, a European mole (*Talpa europaea*), also were identified, and most of them came from the longhouses at Vésztő-Bikeri. As noted earlier, some may be commensal, suggesting prolonged habitation in longhouse structures (Tchernov 1991a, 1991b, 1997); others may be intrusive.

The other taxonomic classes or groups of animals (not mammals) made up 51 percent of the NISP for identified Early Copper Age faunal material from Vésztő-Bikeri (Table 14.2). Fish remains accounted for 31 percent of the NISP in the identified assemblage and were represented by at least three species: wels catfish (*Silurus glanis*), common carp (*Cyprinus carpio*), and common roach (*Rutilus rutilus*). Only 2 percent of the NISP was from

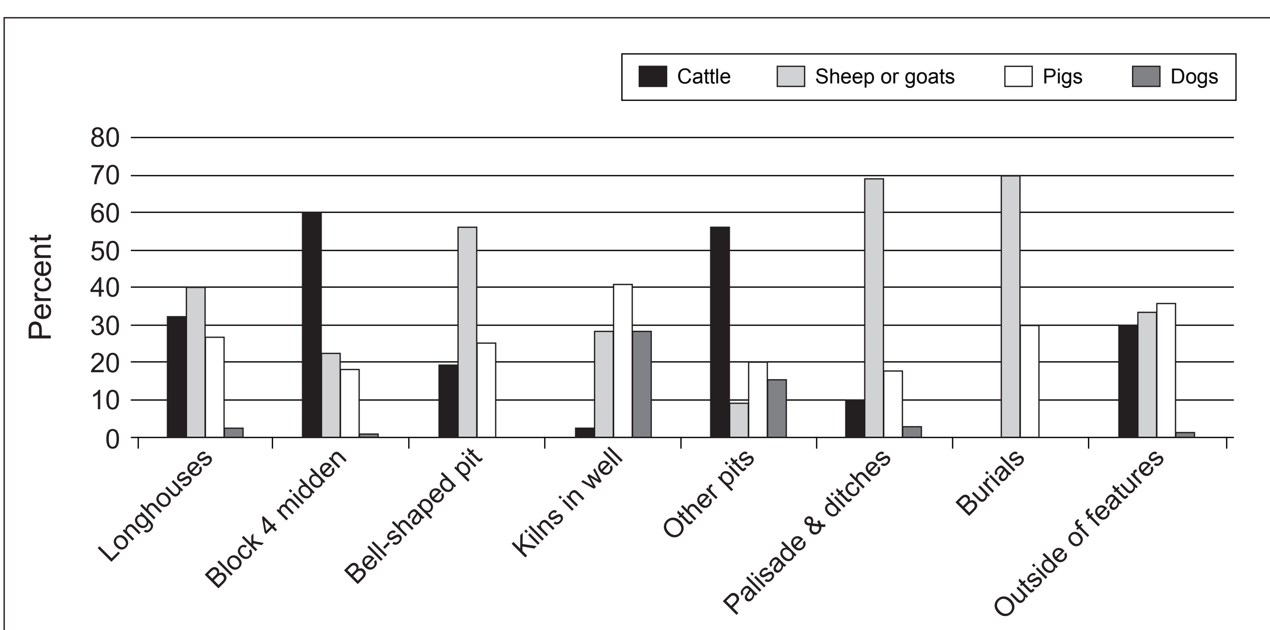


Figure 14.2. Percentage of NISP for domesticated animals from Early Copper Age excavation contexts at Vésztő-Bikeri. Source: Table 14.3:I. *Figure by Amy Nicodemus and Richard W. Yerkes.*

Table 14.3. Distribution of domesticated animals by context at Vésztő-Bikeri and Körösladány-Bikeri. Number of identified specimens (NISP) and percentages (%) in Early Copper Age contexts

I. Vésztő-Bikeri		Longhouses		Block 4 Midden		Bell-Shaped Pit		Kilns in Wells		Other Pits		Palisade and Ditches		Burials		Units Outside Features		Total	
Domestic Mammals		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Bos taurus	cattle	402	*32%*	459	*60%*	3	*19%*	1	*2%*	51	*56%*	13	*10%*	0	*0%*	164	*30%*	**1,093**	***38%***
Ovis/Capra	sheep/goat	503	*40%*	166	*22%*	9	*56%*	13	*28%*	8	*9%*	87	*69%*	7	*70%*	180	*33%*	**973**	***34%***
Sus domesticus	domestic pig	330	*26%*	137	*18%*	4	*25%*	19	*41%*	18	*20%*	22	*17%*	3	*30%*	198	*36%*	**731**	***26%***
Canis familiaris	domestic dog	26	*2%*	3	*<1%*	0	*0%*	13	*28%*	14	*15%*	4	*3%*	0	*0%*	5	*1%*	**65**	***2%***
Total		**1,261**	***100%***	**765**	***100%***	**16**	***100%***	**46**	***99%***	**91**	***100%***	**126**	***100%***	**10**	***100%***	**547**	***100%***	**2,862**	***100%***

II. Körösladány-Bikeri		Bell-Shaped Pits		Well		Other Pit		Palisade and Ditches		Burials		Units Outside Features		Total	
Domestic Mammals		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Bos taurus	cattle	59	*18%*	27	*16%*	27	*21%*	110	*42%*	7	*33%*	354	*35%*	**584**	***30%***
Ovis/Capra	sheep/goat	70	*21%*	74	*43%*	72	*56%*	106	*41%*	13	*62%*	455	*45%*	**790**	***41%***
Sus domesticus	domestic pig	200	*60%*	70	*41%*	29	*23%*	42	*16%*	1	*5%*	199	*20%*	**541**	***28%***
Canis familiaris	domestic dog	5	*1%*	1	*1%*	0	*0%*	2	*1%*	0	*0%*	5	*<1%*	**13**	***1%***
Total		**334**	***100%***	**172**	***101%***	**128**	***100%***	**260**	***100%***	**21**	***100%***	**1,013**	***100%***	**1,928**	***100%***

III. Adjusted Early Copper Age Totals for Domesticated Animals, Excluding Block 4 Midden					
Site		Vésztő-Bikeri		Körösladány-Bikeri	
Domestic Mammals		N	%	N	%
Bos taurus	cattle	634	*31%*	584	*30%*
Ovis/Capra	sheep/goat	807	*40%*	790	*41%*
Sus domesticus	domestic pig	594	*29%*	541	*28%*
Total		**2,035**	**100%**	**1,915**	***100%***

Table by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.

birds, and only bones from members of the duck subfamily and a falconiform raptor could be assigned to a genus. Unidentified large- and small-bodied bird species accounted for 79 percent of the bird remains. In her analysis of bird remains from the Early Neolithic Ecsegfalva 23 site, Gál (2007:370–72) noted that wing bones were more abundant than legs and other avian body parts at the settlement. This also seems to have been the case at Vésztő-Bikeri. Bird wings with feathers may have been curated by the site's inhabitants (see also Bovy 2002). The majority of the indeterminate medium-size birds are probably waterfowl. European pond turtle is the only identified reptile that may have been eaten or exploited. The snake remains and frog or toad elements probably were intrusive.

Context-dependent variation in the distribution of faunal remains at Vésztő-Bikeri indicates that remains of large mammals, particularly cattle and wild boar, were deposited differentially in the ring midden at the periphery of the village. The remains of most other animals, especially fish, usually were deposited in or near the longhouses at the center of the site. About half of the identified remains (52 percent) came from the longhouses where the largest excavation blocks were located, and while the relative abundance of remains there is similar to the relative abundance in the Early Copper Age total, domesticated mammals were slightly underrepresented while fish were slightly overrepresented (see Table 14.2:VIII). When the results from the Bikeri sites are compared with the relative abundance of domesticated and wild species in faunal assemblages from other Early Copper Age sites, NISP from houses, middens, and other contexts must be separated before meaningful comparisons can be made.

NISP, MNI, and Estimated Meat Weights at Vésztő-Bikeri

The rank order of most identified species is similar at Vésztő-Bikeri whether NISP or MNI is used to estimate taxonomic abundance (Table 14.4:I). NISP was used when comparing the abundance of remains of different animals found in different contexts at Vésztő-Bikeri and Körösladány-Bikeri. The large amount of fragmented remains made calculation of MNI difficult, and meat weight is based on MNI. Ranking by meat weight may therefore not be entirely accurate, but it provides a more realistic view of the contributions of different animals to the Early Copper Age diet. The bones of cattle are often more fragmented than ovicaprine or pig elements, perhaps because cattle long bone shafts frequently were broken into fragments that were used to make tools (see Chapter 11, this volume). The numerous cattle shaft elements could not be used to calculate MNI since they could not be "paired" like the proximal or distal ends of long bones (Klein and Cruz-Uribe 1984:26). Fish and bird bones are distinctive, and small fragments can be assigned to either taxonomic group, which elevates the NISP, but these fragile fish and bird bones rarely are recovered intact, reducing the number of skeletal elements that can be used to calculate MNI and estimate meat weight. Plastron and carapace fragments of the pond turtle also are distinctive, and also elevate the NISP, but they are not as useful for MNI calculations.

The three measures of the relative importance of different animals in Early Copper Age diet and economy are complementary, and they produced similar rankings (Table 14.4). At Vésztő-Bikeri, using NISP and MNI, the top four animal species or classes are fish (NISP rank 1, MNI rank 2), cattle (NISP rank 2, MNI rank 4), sheep or goat (NISP rank 3, MNI rank 1), and pig (NISP rank 4, MNI rank 2—tied with fish). When meat weight is considered, fish drop out of the top four (weight rank 9), and aurochs move up (weight rank 4, NISP rank 12, MNI rank 13). The top three by weight are cattle, pigs, and sheep or goats (Table 14.4:I). It seems clear that livestock provided most of the meat in the Early Copper Age diet (and other products of domestication), although the percentage of domesticated mammals varies, from 57 percent of the NISP and MNI to 84 percent of the total estimated meat weight for Vésztő-Bikeri (Table 14.4:I).

Fish remains were common but accounted for less than 1 percent of the total estimated meat weight. Birds ranked fifth in NISP and MNI, but their meat contribution was less than 0.1 percent. The ranks of all other wild animals ranged from 7 to 15 for NISP (and accounted for 3 percent of the total NISP) and 6 to 15 for MNI (and 23 percent of the total MNI). The ranks of all wild animals for estimated meat weight ranged from 5 to 13, and their contribution was 16 percent of the total (8 percent of this was from aurochs; see Table 14.4:I).

Body Part Representation at Vésztő-Bikeri

Body part distribution for identified domesticated mammals in the Early Copper Age assemblage from Vésztő-Bikeri was tabulated using a sample of 1,480 identifiable skeletal elements from livestock. The five body regions are head, trunk, upper meaty limbs, lower dry limbs, and terminal bones (for lists of bones in each region, see Table 14.1:I). The average numbers of bones from each region for cattle, sheep/goats, and pigs is shown in Tables 14.1:II and 14.5:I. Those percentages can be used to estimate how many elements from each region would be expected in

Table 14.4. Identified fauna from Early Copper Age contexts at Vésztő-Bikeri and Körösladány-Bikeri by NISP, MNI, and estimated meat weight

		I. Vésztő-Bikeri									II. Körösladány-Bikeri								
Species/ Taxon	Common Name	NISP			MNI			Meat			NISP			MNI			Meat		
		NISP	NISP %	Rank	MNI	MNI %	Rank	Weight (kg)	Meat %	Rank	N	NISP %	Rank	N	MNI %	Rank	Weight (kg)	Meat %	Rank
Pisces	all fish	1,824	37%	1	17	18%	2	8.5	0.2%	9	1,311	35%	1	12	18%	1	7.0	0.2%	9
Bos taurus	cattle	1,093	22%	2	12	13%	4	3,000	58.7%	1	584	16%	3	6	9%	4	1,500	48.8%	1
Ovis/Capra	sheep/goat	973	20%	3	25	26%	1	625	12.2%	3	790	21%	2	12	18%	1	300	9.8%	4
Sus domesticus	pig (domestic)	731	15%	4	17	18%	2	680	13.3%	2	541	15%	4	6	9%	4	240	7.8%	5
Aves	all birds	99	2%	5	7	7%	5	2	<0.1%	11	248	7%	5	8	12%	3	3	0.1%	10
Canis familiaris	dog (domestic)	65	1%	6	2	2%	6	n/a	n/a	n/a	13	<1%	9	2	3%	8	n/a	n/a	n/a
Emys orbicularis	pond turtle	55	1%	7	2	2%	6	0.5	<0.1%	13	29	1%	7	2	3%	8	0.5	<0.1%	13
Cervus elaphus	red deer	33	1%	8	2	2%	6	200	3.9%	5	13	<1%	9	1	2%	11	100	3.3%	6
Capreolus capreolus	roe deer	32	1%	9	2	2%	6	30	0.6%	7	52	1%	7	4	6%	7	60	2.0%	7
Sus scrofa	wild boar	27	1%	10	2	2%	6	150	2.9%	6	89	2%	6	6	9%	4	450	14.6%	2
Lepus europaeus	brown hare	18	<1%	11	2	2%	6	1.5	<0.1%	12	26	1%	8	2	3%	8	1.5	<0.1%	12
Bos primigenius	aurochs	8	<1%	12	1	1%	13	400	7.8%	4	3	<1%	12	1	2%	11	400	13.0%	3
Castor fiber	beaver	2	<1%	13	1	1%	13	10	0.2%	8	5	<1%	11	1	2%	11	10	0.3%	8
Mustelidae	mustelid	2	<1%	13	2	2%	6	3	0.1%	10	1	<1%	13	1	2%	11	2	<0.1%	11
Canis lupus	wolf	1	<1%	15	1	1%	15	n/a	n/a	n/a	0	0%		0	0%		0	0.0%	
Sciurus vulgaris	red squirrel	0	0%		0	0%		0	0%		1	<1%	13	1	2%	11	0.5	<0.1%	13
Totals		**4,963**	**100%**		**95**	**100%**		**5,111**	**100%**		**3,706**	**100%**		**65**	**100%**		**3,074**	**100%**	

Table by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.

Table 14.5. Body part representation for livestock at Vésztő-Bikeri and Körösladány-Bikeri based on average number of bones in skeleton

I. Average Number of Bones in the Skeletons of Domesticated Animals (adapted from Schmid 1972)						
Region	**Cattle**		**Ovicaprid**		**Pig**	
	N	**%**	**N**	**%**	**N**	**%**
Head region	51	24.9%	53	25.5%	63	24.9%
Trunk region	59	28.8%	60	28.8%	60	23.7%
Upper (meaty) limbs	20	9.8%	20	9.6%	22	8.7%
Lower (dry) limbs	32	15.6%	32	15.4%	38	15.0%
Terminal bones	43	21.0%	43	20.7%	70	27.7%
Total	**205**	**100%**	**208**	**100%**	**253**	**100%**
II. Actual and Expected NISP from Different Body Regions for Domestic Animals at Vésztő-Bikeri						
Region	**Cattle**		**Ovicaprid**		**Pig**	
	Actual	**Expected**	**Actual**	**Expected**	**Actual**	**Expected**
Head region	**164**	107	**304**	148	**224**	114
Trunk region	**159**	123	*35*	172	*97*	109
Upper (meaty) limbs	**59**	42	**148**	59	**78**	40
Lower (dry) limbs	*30*	66	*71*	89	*28*	69
Terminal bones	*16*	90	*35*	125	*32*	127
Total	**428**	**428**	**593**	**593**	**459**	**459**
III. Actual and Expected NISP from Different Body Regions for Domestic Animals at Körösladány-Bikeri						
Region	**Cattle**		**Ovicaprid**		**Pig**	
	Actual	**Expected**	**Actual**	**Expected**	**Actual**	**Expected**
Head region	**158**	87	**206**	144	**167**	105
Trunk region	*16*	101	*21*	162	*40*	101
Upper (meaty) limbs	**74**	34	**163**	54	**105**	37
Lower (dry) limbs	**66**	54	**119**	87	*55*	64
Terminal bones	*35*	73	*54*	116	*58*	118
Total	**349**	**349**	**563**	**563**	**425**	**425**

Notes: Bold numbers are more than expected. Numbers in italics are less than expected. *Table by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.*

faunal assemblages if entire animals were butchered on-site, and the expected frequencies can be compared with the actual frequencies based on NISP (Table 14.5:II).

For cattle remains at Vésztő-Bikeri, the NISP values for the frequency of elements from the head, trunk, and upper meaty limbs regions were higher than expected. There were fewer lower dry limb bones and terminal bones. For the ovicaprines and pigs, there were more bones from the head region and meaty upper limb bones, and fewer bones from the trunk, dry lower limb, and terminal bone regions than expected. If the animals were butchered at the site, the underrepresented elements (lower limb and terminal bones), which have less meat, may have been used to make bone tools, or may have been lost or discarded in contexts that were not excavated. The lower numbers of recovered trunk elements from sheep, goats, and pigs may be due to a higher rate of fragmentation for trunk elements in ovicaprines and pigs than in cattle or may be the result of different processing methods for those species.

Further insights can be gained by looking at the frequencies of all livestock bones from the five body regions found in different excavation contexts at Vésztő-Bikeri (Figure 14.3). When compared to the average for cattle, sheep/goats, and pigs, far fewer lower dry limb bones and terminal bones were deposited in the excavated contexts. The central areas of Vésztő-Bikeri (longhouse structures, the bell-shaped pit, and the other pit features), the Block 4 midden, and the EUs outside of features all have similar frequencies. Most bones were from the head and trunk regions: 39–45 percent and 36–42 percent, respectively. The percentages of upper meaty limbs (7–12 percent) were similar to the average for domesticated mammals (10 percent). In the fill of the palisade and ditches, most of the bones were from the head region (46 percent), but there were fewer bones from the trunk (24 percent) and more from the upper meaty limbs (16 percent) than from other contexts. The trunk and upper meaty limbs are the portions of the skeleton with the highest quantity and quality of meat and marrow. The frequency of upper meaty limb bones in all contexts (except the Block 4 midden, where only 7 percent were upper meaty limb bones) matched (10 percent) or exceeded (12–16 percent) the average for domesticated species (Figure 14.3).

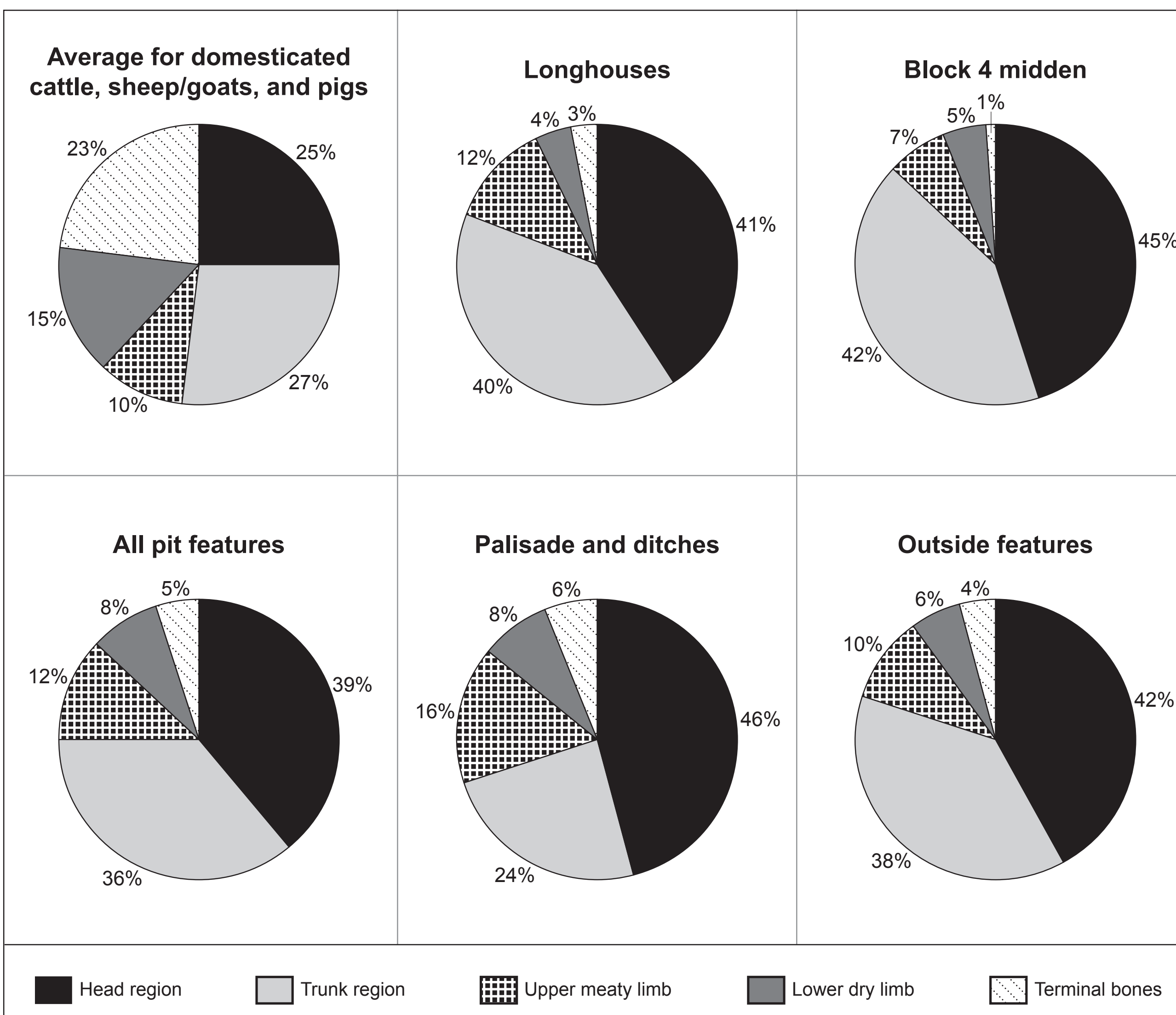


Figure 14.3. Frequencies of elements from different regions of the mammal skeletons from Early Copper Age excavation contexts at Vésztő-Bikeri. *Figure by Amy Nicodemus and Richard W. Yerkes.*

There was a slightly different pattern when each livestock species was considered separately. Cattle body part representation resembles the combined livestock frequencies (Figure 14.3), except that trunk bones slightly outnumber cranial elements in the longhouses, all pits, and Block 4 midden samples. The sample sizes were relatively small for cattle, particularly the sample from the palisade and ditches. Sheep/goat remains were not as uniformly distributed. In the Block 4 midden, sheep or goat trunk elements were more common than the frequency for all livestock, and there were almost no meaty upper limb elements. Pig body parts were heterogeneously distributed across the site. As with all livestock (Figure 14.3), the trunk region was overrepresented and meaty upper limbs were underrepresented in the Block 4 midden. Additionally, there were fewer pig trunk elements in the pits. Upper meaty limb fragments of pigs were more abundant than the combined frequency for all livestock in the fill of the palisade and ditches.

The notable differences between the frequencies of elements from different body parts in the excavated contexts and the expected frequencies based on average number of elements for the livestock were in the relative proportions of head and trunk bones (higher than expected) and lower dry limb and terminal bones (lower than expected; see Figure 14.3). Along with the upper meaty limb bones, the overrepresented body parts were portions of the skeleton with the highest quantity and quality of meat and marrow. Body part distribution patterns are a combination of butchering, disposal, and density-mediated attrition and fragmentation. The head is dominated by mandibular and maxillary elements (mostly teeth), which often are identifiable. The trunk consists of fragile bones that are greatly affected by fragmentation and often not identifiable to species. However, at Vésztő-Bikeri this was not the case. Trunk elements were more common than expected except in the palisade and ditches. The frequencies of upper limbs clearly demonstrate that less dense, but meatier, elements were more abundant, while denser lower dry limbs either were used to make bone tools, lost, or disposed of away from the settlement.

It was not possible to compare frequencies from wild and domesticated mammals, since the sample sizes for several species were very small. However, for the large game, bones from most of the body regions were recovered. There were no terminal bones from aurochs and wild boar found at Vésztő-Bikeri, so some primary butchering may have occurred away from the village. Beaver and wolf were represented solely by phalanges. These skeletal elements may have been parts of pelts. The fragile fish remains were highly fragmented and few bones were identifiable to genus or species. However, there was no significant discrepancy between the number of individuals represented by cranial and post-cranial vertebral elements, indicating that fish were brought to the site whole. Wing bones were more common than trunk or leg bones from the birds.

Age Profiles of the Animals from Vésztő-Bikeri

Both post-depositional attrition and sampling error have affected which elements are represented at the site, and consequently the reconstructed age profiles (Payne 1975). For all domesticated species, fusion profiles tend to be biased toward older individuals due to differential destruction of more fragile juvenile animal bones (Munson and Garniewicz 2003). On the other hand, while both juvenile and adult teeth preserve well, the dental samples were only a fraction of the size of the samples of post-cranial remains. Late-stage tooth wear patterns have not been correlated with absolute ages for cattle and pigs, so resolution was poor for mature and senile animals. Dental and epiphyseal fusion profiles were averaged for comparison against theoretical specialized animal utilization profiles (Payne 1973). Livestock age profiles from Vésztő-Bikeri resemble Payne's theoretical meat utilization pattern rather than patterns for dairying (milk production) or wool production (Figure 14.4). The frequencies of different age groups in faunal samples were subject to different discard patterns and the recovery biases described above. Payne's meat model may not be appropriate for primitive breeds, since young animals are needed to stimulate lactation. Yet the mortality curves for milk production could match Payne's meat model (Clutton-Brock 1981; Halstead 1996; Halstead and Isaakidou 2011; McCormick 1992). Payne's models are based on idealized strategies, each with a single goal (obtaining milk or wool, using animals for traction, or slaughtering them for meat), and it is more likely that the Vésztő-Bikeri villagers practiced a more complex pattern of animal husbandry with several complementary goals.

In both cattle and ovicaprines, about 25 percent of the animals were kept well into adulthood (eight and six years, respectively) for breeding or possibly for the use of some secondary products of domestication, while almost no pigs were kept beyond four years. This pattern would be expected, as pigs reproduce more rapidly and in greater numbers, so fewer mature pig females are required to maintain a stable population, and pigs do not provide labor, milk, wool, or hair.

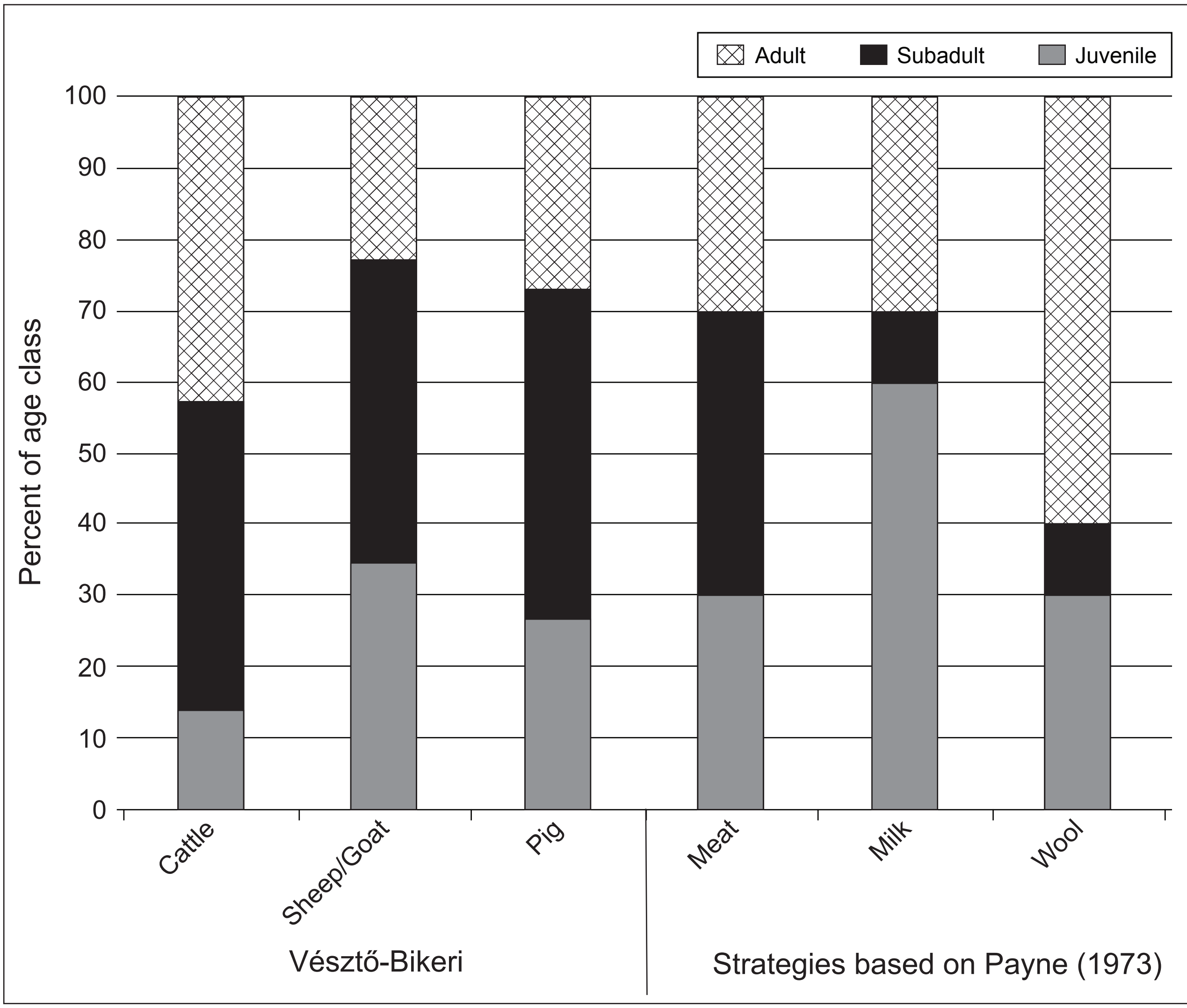


Figure 14.4. Age class frequencies based on dental features and epiphyseal fusion for Early Copper Age livestock from Vésztő-Bikeri (left) compared to frequencies for theoretical animal management strategies (right) proposed by Payne (1973). *Figure by Amy Nicodemus and Richard W. Yerkes.*

The Körösladány-Bikeri Faunal Assemblage

From Körösladány-Bikeri, 14,359 animal bone, antler, scale, and shell fragments were hand-collected or recovered by sifting and flotation processing (Table 14.6). This includes 157 tiny fragments recovered from flotation samples that could be classified only as unidentified vertebrates, leaving 14,202 elements that were sorted into the gross vertebrate groups or classes. At Vésztő-Bikeri, all the faunal material was from the Early Copper Age occupation, except the finds associated with two Hungarian Conquest period burials. This was not the case at Körösladány-Bikeri, where there were several later episodes of use and occupation. Of the 14,202 sorted faunal remains, 1,343 were associated with Late Bronze Age (circa 1300–900 cal BC) features and 261 were recovered from Sarmatian period features (second to fourth century AD). The remaining 12,755 faunal pieces, including unidentified vertebrates, were recovered from Early Copper Age contexts, leaving the total of identified Early Copper Age remains at 12,598. If the 210 remains from rodents, insectivores, or other micromammals, the 168 unidentified reptile elements, the 346 amphibian bones, the 125 land snail fragments, and 13 bones from domesticated dogs—which probably were not used for food or fiber—are excluded, there were 11,736 fragments from animals consumed or exploited by the Early Copper Age inhabitants of Körösladány-Bikeri. Thus, although the site is multicomponent, 93 percent of the recovered mammal, fish, bird, reptile, amphibian, and mollusk remains derives from Early Copper Age contexts at the site (excluding the 157 unidentified vertebrate fragments; Table 14.6).

However, due to the high degree of fragmentation, out of the 9,733 larger mammal bone fragments (excluding dogs, rodents, insectivores, and other micromammals) from Early Copper Age contexts at Körösladány-Bikeri, only 2,118, or 22 percent, could be assigned to a genus or species (Table 14.6). Those 2,118 identified mammal elements included 1,915 from domesticated mammals (90 percent, excluding 13 dog fragments) and only 190 from wild mammals (10 percent). Of the 9,733 larger mammal bones (excluding dogs), 4,940 fragments from Körösladány-Bikeri (51 percent) could only be placed in size classes or groups, and 2,688 fragments (28 percent) could be identified only as indeterminate mammal.

As shown in Table 14.6, of the 4,108 identifiable elements from consumed or exploited species during the Early Copper Age at Körösladány-Bikeri, 1,915 (47 percent) are from domesticated mammals, 190 (5 percent) are from wild mammals, 1,311 (32 percent) are fish remains, 248 (6 percent) are from birds, 29 (1 percent) are from European pond turtles (*Emys orbicularis*), and 415 (10 percent) are freshwater mussels (*Unio* sp.). Totals from the Late Bronze Age and Sarmatian features also are listed in Table 14.6. The only element from a horse (*Equus caballus*), a metapodial bone made into an ice skate, came from a Sarmatian pit. As at Vésztő-Bikeri, no domesticated horse remains were identified in undisturbed Early Copper Age contexts at Körösladány-Bikeri.

Overview of the Körösladány-Bikeri Faunal Assemblage

Table 14.6 lists the NISP in the Körösladány-Bikeri faunal assemblage from six different excavation contexts. Comparisons of NISP of animals in four of the six categories from five of the six contexts were significantly different (Figure 14.5). The results of a chi-square test were $\chi^2 = 989$, T(0.01) = 26.22, df = 12. Pond turtles, mussels, and Early Copper Age burials were not included because of the small sample sizes. There were more domesticated mammals than expected in the well (observed = 172, expected = 164), in the other features (observed = 128, expected = 106), in the palisade and ditches (observed = 260, expected = 167), and in EUs outside of features (observed = 1,013, expected = 717). There also were more bird remains (56) than expected (21) in the well. The pattern in the bell-shaped pits was different, with fewer remains of domesticated mammals found (334) than expected (753) but more elements from wild mammals (110), fish (883), and birds (114) than expected (75, 515, and 98, respectively). In fact, 56 percent of NISP in the bell-shaped pits were fish, but only 28 percent were mammals (domesticated = 21 percent, wild = 7 percent). In the other four excavated contexts at Körösladány-Bikeri with large sample sizes, 57 to 71 percent of the NISP were mammals, and fish NISP had a range of 5 to 24 percent. NISP for birds ranged from 3 to 7 percent in most contexts but was 18 percent in the well. Mussels (less than 1–10 percent) were less common. The higher frequency of mussels (27 percent) in the fill of the palisade and ditches may include valves from the redeposited loess subsoil. Turtle remains were very rare—only 1 percent of NISP when present. Only remains of domesticated mammals (NISP = 21), fish (NISP = 7), and one bird bone were found in the Early Copper Age burials (Table 14.6).

The most common domesticated mammals in all Early Copper Age contexts at Körösladány-Bikeri were ovicaprines (41 percent; Table 14.3:II; Figure 14.6). There were only a few fragments suitable for species identification; 17 of them were sheep and six were goat. Cattle were second in NISP frequency (30 percent), but pig remains (28 percent) were almost as common as cattle. Only 13 dog bones were recovered (1 percent). However, there was additional evidence of dog presence in the form of coprolites and gnawing marks on a few bones.

The relative frequencies of domesticated animal remains at Körösladány-Bikeri also varied by context (Tables 14.3:II; Figure 14.6). The results of a chi-square test of the distribution of domesticated cattle, ovicaprines, and pigs in five different contexts showed that they were significantly different: $\chi^2 = 817.89$, T(0.01) = 23.21, df = 10. Because of small sample sizes, Early Copper Age burials and dog remains were not included in the test. Most of the livestock bones were found outside of features at Körösladány-Bikeri. This includes 61 percent of the cattle remains (NISP = 354), 56 percent of sheep/goat bones (NISP = 455), and 37 percent of pig bones (NISP = 199). Conversely, 200 pig bones (37 percent) were found in bell-shaped pits. There were more cattle remains than expected in the fill of the palisade and ditches and outside of the features, where most of the cattle remains were found (NISP = 354; 61 percent). More remains of sheep/goats and pigs were found in the well than expected. There also were more pigs than expected in the bell-shaped pits and more sheep/goats than expected in other features and outside of features (Table 14.3:II).

Among the wild mammals, the bones of wild boar and roe deer were most common in the Körösladány-Bikeri Early Copper Age faunal assemblage (Table 14.6). Remains of red deer and aurochs were less abundant. The most frequent remains of fur-bearing mammals came from brown hare, while there were only a few bones from beaver, steppe polecat, and squirrel (*Sciurus vulgaris*). Most of the wild mammal remains were found in the fill of the bell-shaped pits or in EUs outside of features. Elements from game and fur-bearing animals were less common in the other features, the palisade and ditches of the enclosure, and the well fill. As noted above, no wild mammal remains were recovered from Tiszapolgár burials.

Non-mammalian species account for 21 percent of the 12,598 NISP from Körösladány-Bikeri Early Copper Age contexts (excluding the unidentified vertebrate fragments; Table 14.6). Fish remains constitute 66 percent of the non-mammalian NISP from consumed or exploited animals. Four species were identified during our analysis: northern pike (*Esox lucius*), wels catfish (*Silurus glanis)*, tench (*Tinca tinca*), and bleak (*Alburnus alburnus*). Some unidentified carp and perch species also were recovered at Körösladány-Bikeri. Ducks, geese, and unidentified birds account for 12 percent of the non-mammalian NISP. Pond turtle was the only identified reptile (1 percent of non-mammalian NISP). As at Vésztő-Bikeri, the unidentified reptile and spadefoot (*Pelobates fuscus*), as well as other frog or toad elements, likely were intrusive. Mussel shell fragments made up 21 percent of the non-mammalian NISP.

NISP versus MNI and Estimated Meat Weights at Körösladány-Bikeri

Regardless of whether NISP or MNI was used to calculate taxonomic abundance, the rank order of the majority of identified species was nearly identical at both sites (Table 14.4.II). As was the case at Vésztő-Bikeri, for faunal elements identified to taxon, the NISP for fish was the highest ranked (35 percent of the total), followed by sheep/goats (21 percent), cattle (16 percent), and pigs (15 percent). When MNI was used, fish and sheep/goats were tied for the first rank (18 percent of the total), followed by cattle and pigs, which were tied for rank 4 (9 percent). The NISP for domesticated animals (52 percent of the total) also was higher than the wild vertebrates at Körösladány-Bikeri. However, livestock and dogs accounted for only 39 percent of the total MNI. The positions of cattle, ovicaprines, pigs, and most other animals did not change much when MNI was used rather than NISP to rank species by their relative abundance (Table 14.4:II). MNI calculations did increase the rank of wild boar (NISP = 89; 2 percent of total NISP); it ranked sixth for NISP but was tied for fourth for MNI (9 percent of the total MNI). The rank of most other species at Körösladány-Bikeri was lower when MNI was used (Table 14.4:II).

Cattle accounted for 49 percent of the total estimated meat weight and held the first rank, followed by wild boar (15 percent) and aurochs (13 percent). This assumes that entire carcasses of these animals were consumed. Ovicaprines (10 percent) were ranked fourth and pigs (8 percent) were ranked fifth by meat weight contribution to the diet at Körösladány-Bikeri. The estimated meat weight for red deer (3 percent) and roe deer (2 percent) ranked them sixth and seventh. Fish were ranked first in NISP and MNI but were ranked ninth by meat weight, behind beavers (eighth in meat weight), which ranked eleventh in both NISP and MNI (Table 14.4.II).

Body Part Representation at Körösladány-Bikeri

Body part representation of the identified livestock elements in the Early Copper Age faunal assemblage from Körösladány-Bikeri also was tabulated and compared to the expected numbers of bones from different body regions for each species (Tables 14.1:II, 14.5:I, and 14.5:III). The results indicate that the abundance of bones from various body regions—head, trunk, upper meaty limbs, lower dry limbs, and terminal bones—was similar, but not identical, for cattle, sheep/goats, and pigs (Figure 14.7). There were more bones from the head region and upper meaty limbs than expected and fewer elements from the lower dry limbs and terminal bones than expected for all three species. There also were more cattle bones from the trunk than expected, but there were fewer trunk bones from sheep/goats and pigs than expected (Table 14.5:III). These results were based on the NISP of 1,337 elements from the livestock that could be assigned to a specific body region. The lower limb bones and bones from the trunk were not as numerous as would be expected if entire carcasses of these domesticated animals were butchered, consumed, and discarded within the settlement. It is possible that the underrepresented elements (lower limb and terminal bones), which have less meat, were used to make bone tools, or they may have been lost or discarded in contexts that were not excavated. The lower numbers of recovered trunk elements from sheep, goats, and pigs may reflect more fragmentation of those bones in ovicaprines and pigs than cattle. This also could be due to different processing methods.

Table 14.6. Faunal remains from Körösladány-Bikeri

Taxon	Common Names	Number of Identified Specimens (NISP) in Early Copper Age Contexts					
		Bell-Shaped Pits	Well	Other Pits and Features	Palisade and Ditches	Burials	Units Outside Features
I. Mammals							
Domestic Mammals							
Bos taurus	cattle	59	27	27	110	7	354
Ovis/Capra	sheep/goat	66	71	68	101	13	448
Ovis aries	sheep	2	3	3	5		4
Capra hircus	goat	2		1			3
Sus domesticus	domestic pig	200	70	29	42	1	199
Canis familiaris	domestic dog	5	1		2		5
Equuidae sp.	horse family						
Total Domestic Mammals		**334**	**172**	**128**	**260**	**21**	**1,013**
Wild Mammals							
Bos primigenius	aurochs	1		2			
Sus scrofa	wild boar	75	6	4			4
Cervus elaphus	red deer	3	(14+)	1	2		7(2)
Capreolus capreolus	roe deer	22(1)	2	8	2		18
Canis lupus	wolf						
Lepus europaeus	brown hare	9		2	6		9
Castor fiber	beaver				5		
Mustela eversmanni	steppe polecat				1		
Sciurus vulgaris	red squirrel						1
Total Wild Mammals		**110**	**8**	**17**	**16**	**0**	**39**
Indeterminate Mammals							
Bos/Equus size group	large mammal	245	65	34	125	16	633
Sus/Ovis/Capra/Cervus size	medium mammal	741	192	308	316	12	2,063
Canis/Castor/Lepus size	small mammal	26	2	28	16	0	118
Indeterminent fragment	unidentified mammal	167	1	280	49	1	2,190
Total Indeterminate Mammals		**1,179**	**260**	**650**	**506**	**29**	**5,004**
Total Larger Mammals		**1,623**	**440**	**795**	**782**	**50**	**6,056**
Rodents							
Avricola terrestris	water vole	1		1	4		33
Arvicolinae sp.	genus *Arvicolinae*	1	2				5
Microtus arvalis	common vole						7
Microtus sp.	genus *Microtus*	4					12
Cricetus cricetus	European hamster	2	2	8	4		15
Apodemus sylvaticus	wood mouse						1
Apodemus sp.	field mouse	5					3
Rodentia	unidentified rodent	18		5	7		47
Insectivores and Unidentified Micromammals							
Talpa europaea	European mole						2
Micromammalia	unidentified micromammals				1		20
Total Rodents, Insectivores, and Micromammals		**31**	**4**	**14**	**16**		**145**
Total Mammals		**1,654**	**444**	**809**	**798**	**50**	**6,201**

Early Copper Age Total	Late Bronze Age Total	Sarmatian Period Total	Site Total
584	36	18	**638**
767	47	20	**834**
17		1	**18**
6			**6**
541	28	26	**595**
13	1		**14**
		1	**1**
1,928	**112**	**66**	**2,106**
3			**3**
89			**89**
13(16+)		1	**14(16+)**
52	3	1	**56(1)**
		1	**1**
26		3	**29**
5			**5**
1			**1**
1			**1**
190	**3**	**6**	**199**
1,118	71	16	**1,205**
3,632	235	109	**3,976**
190	73	8	**271**
2,688	654	8	**3,350**
7,628	**1,033**	**141**	**8,802**
9,746	**1,148**	**213**	**11,107**
39			**39**
8			**8**
7			**7**
16			**16**
31	1	8	**40**
1			**1**
8			**8**
77	12	6	**95**
2			**2**
21			**21**
210	**13**	**14**	**237**
9,956	**1,161**	**227**	**11,344**

Table 14.6. Faunal remains from Körösladány-Bikeri *(continued)*

Taxon	Common Names	Number of Identified Specimens (NISP) in Early Copper Age Contexts					
		Bell-Shaped Pits	Well	Other Pits and Features	Palisade and Ditches	Burials	Units Outside Features
II. Fish							
Esox lucius	northern pike	16	3		1		8
Silurus glanis	wels catfish	9					
Tinca tinca	tench	1					
Alburnus alburnus	bleak	1					
Cyprindidae sp.	carp species	5					
Percidae sp.	perch species	14					1
Pisces	unidentified fish	837	74	46	21	7	267
Total Fish		**883**	**77**	**46**	**22**	**7**	**276**
III. Birds							
Anas platyrhynchos	mallard duck	4					1
Anser sp.	geese	4			1		
Anatidae	duck family	22	17	4	11		18
Aves	unidentified birds	84	39	7	10	1	25
Total Birds		**114**	**56**	**11**	**22**	**1**	**44**
IV. Reptiles							
Emys orbicularis	European pond turtle	9	3		5		12
Reptilia	unidentified reptiles	3		3			162
Total Reptiles		**12**	**3**	**3**	**5**		**174**
V. Amphibians							
Pelobates fuscus	common spadefoot	1					1
Rana sp.	frog species	3		1	1		19
Bufo sp.	toad species						3
Anura	unidentified frogs and toads	97	5	20	18	14	163
Total Amphibians		**101**	**5**	**21**	**19**	**14**	**186**
VI. Unidentified Vertebrates							
VII. Mollusks							
Unio	freshwater clam	132	1		122		160
Gastropoda	land snail	13	1		47	1	63
Total Mollusks		**145**	**2**	**0**	**169**	**1**	**223**
Total Fish, Birds, Reptiles, Amphibians, and Mollusks		**1,255**	**143**	**81**	**237**	**23**	**903**
Grand Total		**2,909**	**587**	**890**	**1,035**	**73**	**7,104**
VIII. Percentage of Selected Classes by Context at Körösladány-Bikeri							
Taxon		**Bell-Shaped Pits**	**Well**	**Other Features**	**Palisade and Ditches**	**Burials**	**Units Outside Features**
Domestic mammals		21%	54%	63%	58%	72%	66%
Wild mammals		7%	3%	8%	4%	0%	3%
Fish		56%	24%	23%	5%	24%	18%
Birds		7%	18%	5%	5%	3%	3%
Turtles		1%	1%	0%	1%	0%	1%
Freshwater mussels		8%	<1%	0%	27%	0%	10%
Total %		**100%**	**100%**	**99%**	**100%**	**99%**	**101%**
NISP		**1,582**	**317**	**202**	**447**	**29**	**1,544**

Early Copper Age Total	Late Bronze Age Total	Sarmatian Period Total	Site Total
28			**28**
9	1		**10**
1			**1**
1			**1**
5			**5**
15			**15**
1,252	54	10	**1,316**
1,311	**55**	**10**	**1,376**
5		1	**6**
5			**5**
72	13		**85**
166	2	6	**174**
248	**15**	**7**	**270**
29	19	1	**49**
168	9		**177**
197	**28**	**1**	**226**
2			**2**
24	9		**33**
3			**3**
317	60	11	**388**
346	**69**	**11**	**426**
157			**157**
415		3	**418**
125	15	2	**142**
540	**15**	**5**	**560**
2,642	**182**	**34**	**2,858**
12,755	**1,343**	**261**	**14,359**
Copper Age Total	**Bronze Age Features**	**Sarmatian Features**	**Site Total**
47%	52%	71%	**48%**
5%	1%	6%	**5%**
32%	26%	11%	**31%**
6%	7%	8%	**6%**
1%	14%	1%	**1%**
10%	0%	3%	**9%**
100%	**100%**	**100%**	**100%**
4,121	**204**	**93**	**4,418**

Note: Numbers of antler fragments are in parentheses and were not included in Early Copper Age totals. Contexts for 157 unidentified vertebrate fragments were not included. The category of "Other Features" includes Feature 29 (wall trench), Feature 49 (large pit), Features 15, 16, 34, and 43 (small pits), Features 18, 32, 43, and 44 (postholes), and Features 4 and 7 (artifact concentrations). In VIII, dogs, indeterminate mammals, rodents and insectivores, gastropods, and unidentified vertebrates were not included when calculating percentages. *Table by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.*

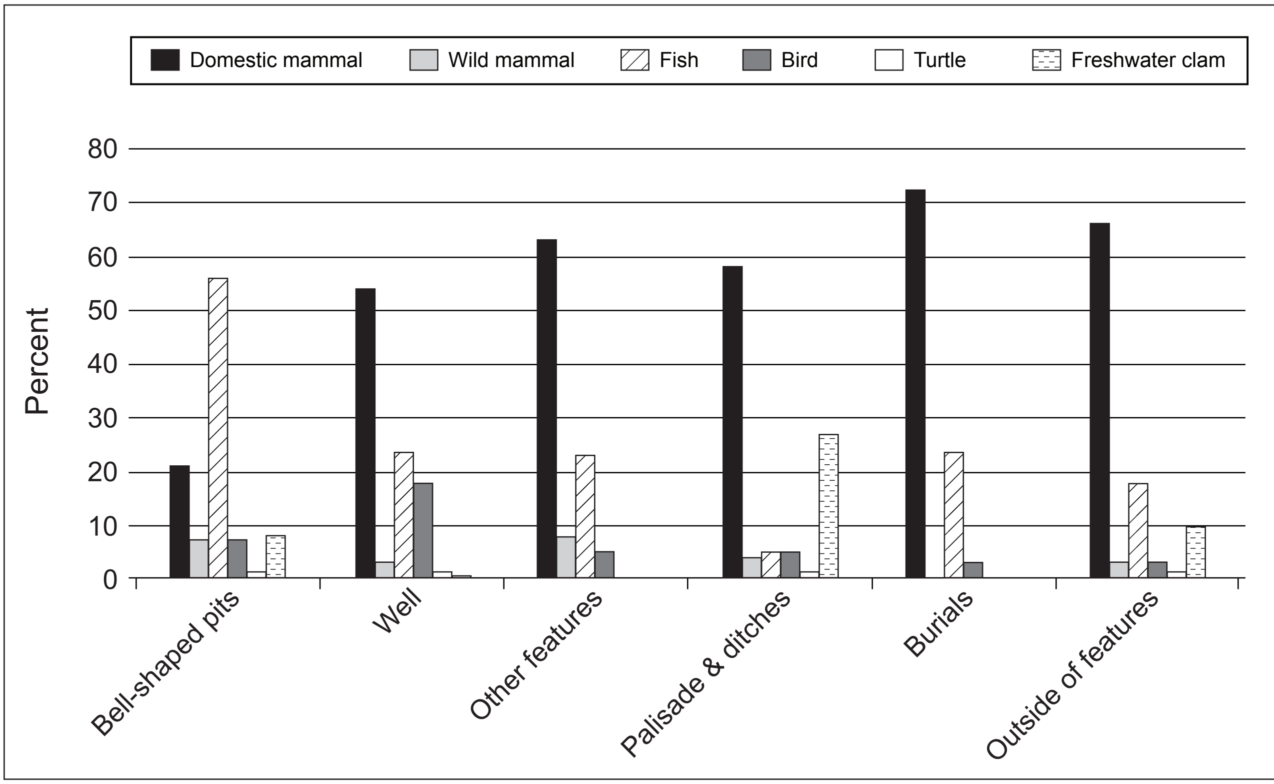


Figure 14.5. Percentage of NISP for animal taxa from Early Copper Age excavation contexts at Körösladány-Bikeri. Source: Table 14.6. *Figure by Zsófia Eszter Kovács and Richard W. Yerkes.*

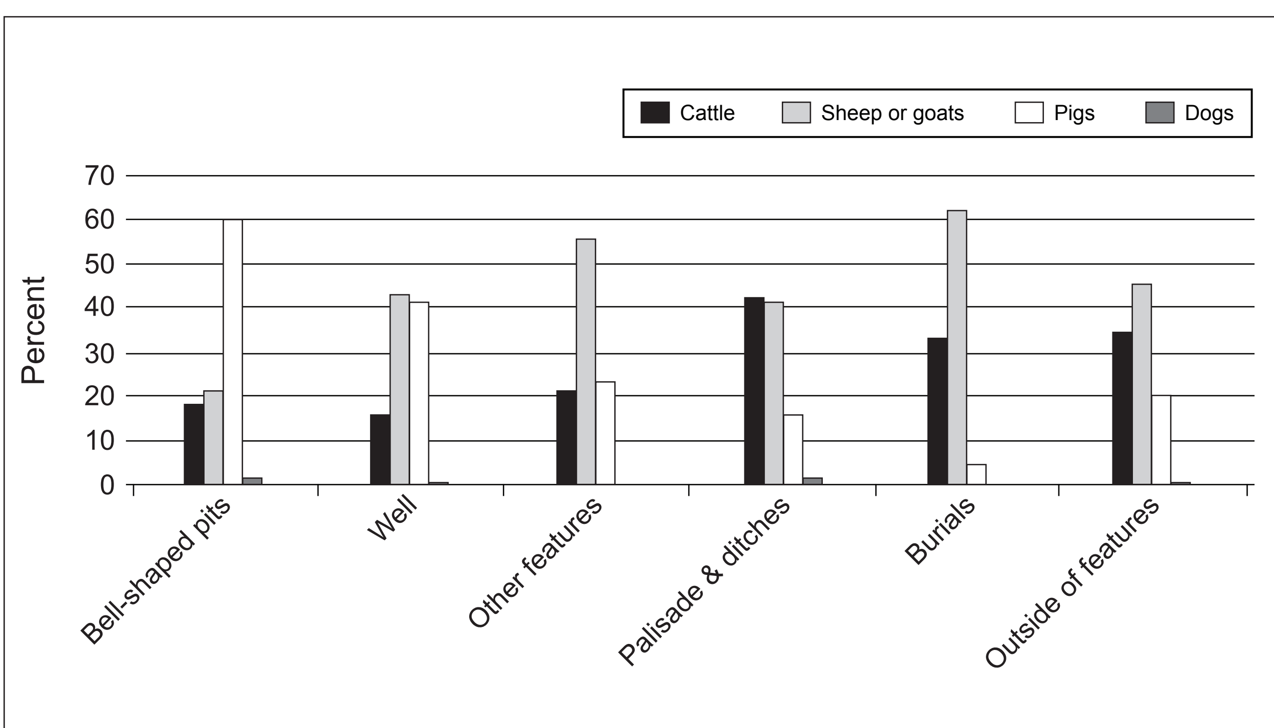


Figure 14.6. Percentage of NISP for domesticated animals from Early Copper Age excavation contexts at Körösladány-Bikeri. Source: Table 14.3:II. *Figure by Zsófia Eszter Kovács and Richard W. Yerkes.*

If the frequencies of all livestock bones from the five body regions found in four different excavation contexts at Körösladány-Bikeri are compared to the average for cattle, sheep/goats, and pigs (Figure 14.7), some interesting patterns emerge. Due to fragmentation, there were only enough identifiable skeletal elements in samples from the bell-shaped pits, the large pit, the well, and the fortification ditches. The relative frequencies of elements from the five body regions of livestock in the fill of these features were different than the average for cattle, sheep/goats, and pigs (Figure 14.7). In all four contexts, more bones from the head region were recovered (30 to 47 percent) than were expected (25 percent), but there were fewer trunk bones (4 to 9 percent) than the expected average (27 percent) and also fewer terminal bones (6 to 15 percent) than expected (23 percent). Lower dry limb bones in the large pit (30 percent) and the palisade and ditches (21 percent) were more abundant than expected (15 percent), but in the bell-shaped pits (18 percent) and well (13 percent) their frequency was close to the expected value. There also was variation in the frequencies of upper meaty limb bones found in the four contexts. In the large pit, the actual frequency matched the expected (10 percent), but in the bell-shaped pits (29 percent), the well (30 percent), and the palisade and ditches (24 percent) there were many more of these high-utility elements than expected. To summarize,

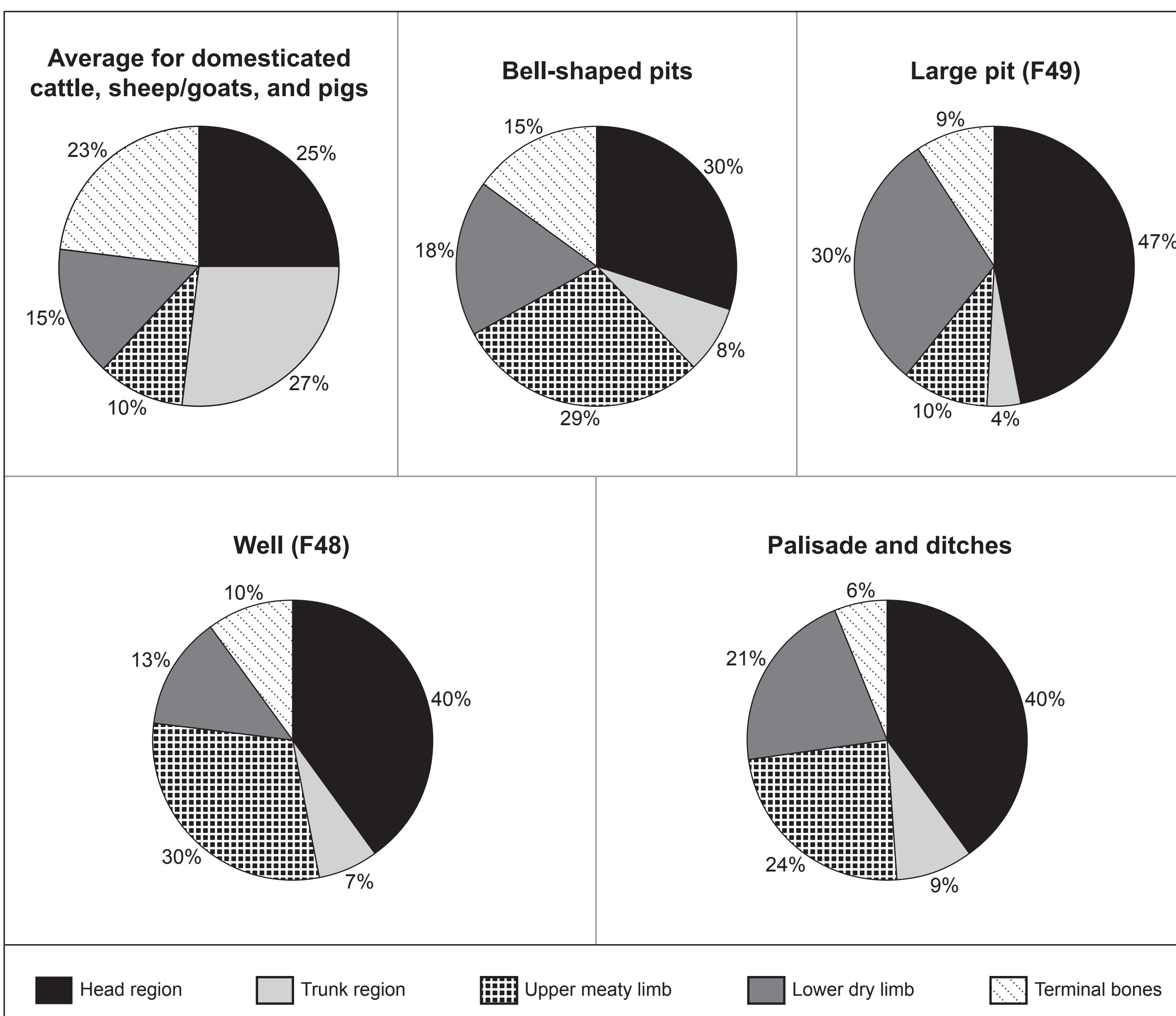


Figure 14.7. Frequencies of elements from different regions of the mammal skeletons from Early Copper Age excavation contexts at Körösladány-Bikeri. *Figure by Zsófia Eszter Kovács* and *Richard W. Yerkes.*

bones from the head are abundant in all four contexts, while bones from the trunk are not. Upper, meaty limb bones are common in the bell-shaped pits, the well, and the ditches but are less abundant in the large pit. This pit also had more lower dry limb bones than the other features.

Sample sizes were small, but when the relative abundance of elements from each body region in the four excavated contexts for the three species of livestock were compared, some differences were noted. For cattle, bones from the head were abundant in the large pit of Feature 49, while lower limb and terminal bones are less common. High-utility, meaty upper limb bones and trunk elements from cattle were not found in this context. There was a similar pattern in the well, where cattle elements from the head also were abundant, lower limb and terminal bones were less common, and meaty upper limb bones and trunk elements were rare. Upper limb bones were more abundant in the bell-shaped pits and the ditches, but the proportion of lower limb bones from cattle was about the same as the percentage in the well and the large pit (Figure 14.7).

There were more high-utility, meaty limb and trunk sheep/goat elements in the ditches of the enclosure, the well, and the bell-shaped pits than high-utility cattle bone fragments, but low-utility, dry limb and terminal bones from sheep/goats were also abundant in those features and in Feature 49 (where there were fewer high-utility elements). Bones from the trunk region of ovicaprines were not very common in any of the features, and there were very few ovicaprine terminal bones in the ditches.

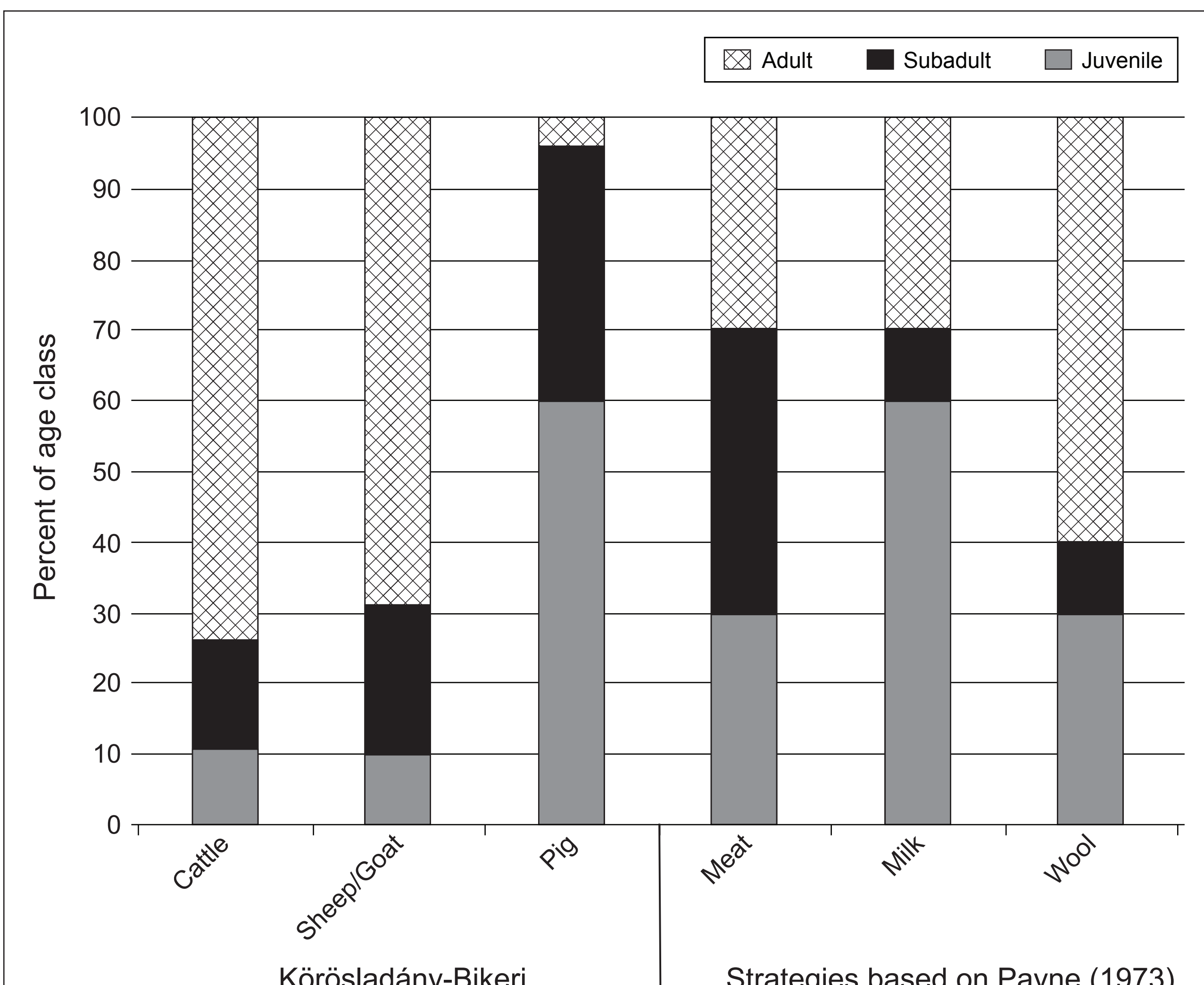


Figure 14.8. Age class frequencies based on dental features and epiphyseal fusion for Early Copper Age livestock from Körösladány-Bikeri (left) compared to frequencies for theoretical animal management strategies (right) proposed by Payne (1973). *Figure by Zsófia Eszter Kovács and Richard W. Yerkes.*

The body part distribution for pigs is similar to the pattern for both cattle and ovicaprines in the bell-shaped pits. The well was the only other feature where upper meaty limb bones from pigs were abundant. Most of the identified pig elements were terminal bones or from the head and lower dry limbs and would be classified as elements with low utility.

These distribution patterns may indicate that cattle butchering took place at several locations across the Körösladány-Bikeri site, and a great amount of butchering refuse (low-utility elements) ended up in the large Feature 49 pit and the Feature 48 well in Block 7. Most of the meaty upper limbs of cattle were discarded in the bell-shaped pits in the center of the site or in the fill or the enclosure ditches. However, while most of the meaty limb bones of pigs were found in the bell-shaped pits and the well, the meaty limb bones from sheep or goats were more evenly distributed among the different types of features. In general, the remains of the smaller livestock (sheep, goats, and pigs) were more abundant in the bell-shaped pits and the well at Körösladány-Bikeri than they were in the ditches, while the opposite appears to be the case for cattle. It seems that the remains of small domesticates were placed in the features in the central habitation area, while cattle remains were deposited at the periphery of the settlement. Thus there were different depositional patterns for small and large animal refuse, which is quite understandable since processing cattle produces a greater amount of waste than butchering small goats, sheep, or pigs, whose smaller bones could be disposed of within the habitation area.

Age Profiles of the Animals from Körösladány-Bikeri

Tooth eruption and epiphyseal fusion patterns were used to estimate the age at death of the livestock from Körösladány-Bikeri, but sample sizes were small. The most common species in the Early Copper Age assemblage were ovicaprines. Sixty-nine percent of the remains represent adult animals, while 31 percent were killed before they reached breeding age (10 percent juvenile and 21 percent subadult; Figure 14.8). This kill-off pattern raises the possibility of secondary exploitation of sheep and goats for their milk and fiber products. Cattle remains were less abundant than sheep/goats at Körösladány-Bikeri. Age estimations show the dominance of adult cattle (74 percent), similar to the pattern for the ovicaprines (Figure 14.8). There were fewer young animals (11 percent juvenile and 15 percent subadult). This age profile also suggests that some cattle were kept for their milk and/or labor. Pig remains at the site were nearly as common as cattle. There is a different pattern for pigs than there is for sheep, goats, and cattle. Young individuals clearly dominated (60 percent juvenile and 36 percent subadult), while the percentage of adults was very low (4 percent; Figure 14.8). This kill-off pattern indicates that pigs were raised for their meat at Körösladány-Bikeri.

Sample sizes from the site are too small for statistical comparisons for other mammals. The low frequency of remains of wild animals at Körösladány-Bikeri suggests that hunting was complementary to animal husbandry. Large game dominated in the wild mammal assemblage in contrast to smaller, fur-bearing mammals. It seems that the main purpose of hunting was to obtain meat, hides, antlers, and sinew. Hunting animals to obtain pelts seems to have been less important. There were not enough teeth and suitable bone fragments from wild animals to construct age profiles.

Comparing the Two Early Copper Age Faunal Assemblages

If the percentages of the NISP for different animal taxa represented in the faunal samples from all the excavated contexts at the two Early Copper Age Bikeri settlements are compared, it appears that there were fewer cattle remains at the younger Körösladány-Bikeri village but more sheep/goat remains (see Tables 14.3 and 14.7). There is a slight increase in the frequency of pig remains at Körösladány-Bikeri and also a moderate increase in the abundance of wild mammal remains. There is also an 8 percent increase in large mammal remains that could not be identified to species. The NISP for unidentified mammals was 53 percent of the total NISP (excluding tiny unidentified vertebrate fragments) at Vésztő-Bikeri and 61 percent of the total NISP at Körösladány-Bikeri.

However, these differences in taxonomic abundance between the two Bikeri settlements may not have been the result of changing subsistence strategies over time. The excavated contexts at the two sites were not identical, and the animal remains were not evenly distributed among the different areas and features. One excavation block at Vésztő-Bikeri, Block 4, was a 2 x 2 m unit located in the ring midden at the periphery of the site (see Chapter 7, this volume). Most of the faunal remains found in this midden sample were from cattle (459, or 30 percent of the total NISP of 1,589) and account for 60 percent of the 765 NISP of domesticated mammals (see Table 14.3:I). Almost all the animal remains from the Block 4 midden (97 percent) were mammals (domesticated = 93 percent, wild = 4 percent wild). Remains of fish, birds, turtles, and mussels amounted to only 3 percent of the total NISP (see Table 14.2).

By comparison, none of the faunal material from Körösladány-Bikeri came from comparable midden contexts. If the material from the Block 4 midden at Vésztő-Bikeri is omitted from the analysis, and if only animals that were consumed or exploited are compared, there is virtually no difference in the frequencies of mammal remains from the two sites (see Table 14.7). At Vésztő-Bikeri (excluding the Block 4 midden), sheep/goats made up 37 percent of the NISP for animals consumed or exploited, while 29 percent were from cattle and 27 percent were from domesticated pigs. Nine species of wild animals accounted for 7 percent of the total NISP identified to species at Vésztő-Bikeri. At Körösladány-Bikeri, 37 percent of the NISP were from sheep/goats, 27 percent were from cattle, and 25 percent were from domesticated pigs, while 11 percent came from wild mammals. When NISP for the most common mammals, the livestock, were compared, the frequencies for Körösladány-Bikeri were 30 percent cattle, 41 percent sheep/goats, and 28 percent pigs (see Figure 14.9). At Vésztő-Bikeri, when remains from all contexts were included, there were more cattle (39 percent of the NISP), fewer sheep/goats (34 percent), and about the same amount of pig remains (27 percent). However, if the material from Block 4 at Vésztő-Bikeri was omitted, then the Vésztő-Bikeri frequencies were 31 percent cattle, 40 percent sheep/goats, and 29 percent pigs, nearly identical to the values from Körösladány-Bikeri (see Figure 14.9).

If total NISP for the identified larger mammals (domesticated and wild), fish, and birds are compared, and if the Block 4 midden assemblage from Vésztő-Bikeri is not included, the percentage of NISP for larger mammals at Vésztő-Bikeri is 85 percent, while it is 86 percent at Körösladány-Bikeri. At Vésztő-Bikeri, 14 percent of the NISP was from fish and 1 percent was from birds. At Körösladány-Bikeri, these amounted to 12 percent and 2 percent of the total (see Table 14.7). The MNI and meat weight contribution of fish at both sites were identical (MNI = 18 percent, meat weight = 0.2 percent; see Table 14.4), and the meat weight values are probably a more accurate reflection of the contribution of fish to the Early Copper Age diet than the percentage of the NISP.

With or without the adjustment made by excluding the material from the Block 4 midden assemblage from Vésztő-Bikeri, animal-based diet and economy did not change much during the entire span of time that the two adjacent Early Copper Age villages were occupied (for changes in plant production and consumption at the sites, see Chapter 15, this volume). Livestock provided the bulk of the meat, hides, and materials for tools and ornaments, supplemented by game, fish, birds, turtles, and freshwater mussels. All three species of livestock, cattle, sheep/goats, and pigs, were part of the mixed herds of domestic animals. There was no specialization on one species. Cattle remains may have been underrepresented

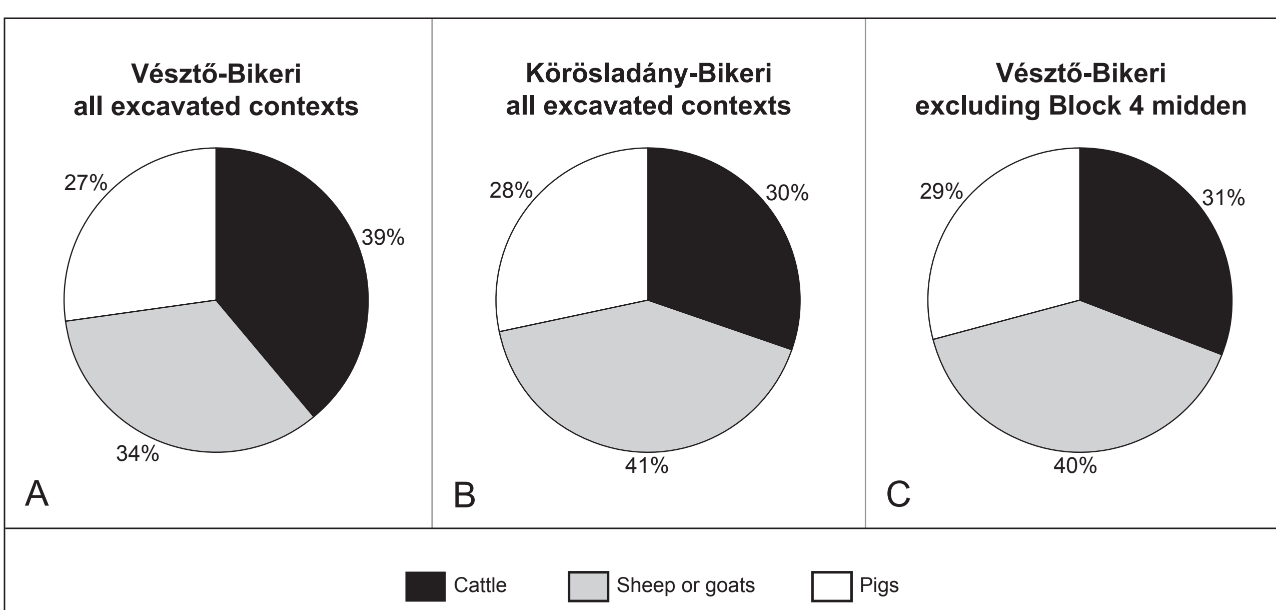


Figure 14.9. A: Percentages of domesticated livestock from Vésztő-Bikeri, NISP = 2,797; B: Percentages from Körösladány-Bikeri, NISP = 1,915; C: Percentages from Vésztő-Bikeri not including the faunal material from the Block 4 midden, NISP = 2,035. *Figure by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.*

Table 14.7. Comparison of faunal remains from Vésztő-Bikeri and Körösladány-Bikeri

I. Faunal Remains from All Excavation Contexts							
Taxon	**Common Names**	**Vésztő-Bikeri Early Copper Age NISP Totals**			**Körösladány-Bikeri Early Copper Age NISP Totals**		
I.1. Mammals							
I.1.a. Domesticated Mammals		**N**	**Group %**	**% of Total**	**N**	**Group %**	**% of Total**
Bos taurus	cattle	1,093	38%		584	30%	
Ovis/Capra	sheep/goat	910	32%		767	40%	
Ovis aries	sheep	42	1%		17	1%	
Capra hircus	goat	21	1%		6	<1%	
Sus domesticus	domestic pig	731	26%		541	28%	
Canis familiaris	domestic dog	65	2%		13	1%	
Equuidae	horse family	7*	n/a		n/a	n/a	
Total Domesticated Mammals (*horse not included)		**2,862***	**100%**	**18%**	**1,928**	**100%**	**15%**
I.1.b. Wild Mammals							
Bos primigenius	aurochs	8	1%		3	2%	
Sus scrofa	wild boar	27	22%		89	47%	
Cervus elaphus	red deer	33	27%		13	7%	
Capreolus capreolus	roe deer	32	26%		52	27%	
Canis lupus	wolf	1	1%		0	0%	
Lepus europaeus	brown hare	18	15%		26	14%	
Castor fiber	beaver	2	2%		5	3%	
Sciurus vulgaris	red squirrel	0	0%		1	1%	
Mustelidae	mustelids	2	2%		1	1%	
Total Wild Mammals		**123**	**100%**	**8%**	**190**	**100%**	**2%**
Identified Large Mammals (*horse not included)		**2,985***			**2,118**		
Bos/Equus size group	large mammal	508	6%		1,118	15%	
Sus/Ovis/Capra/Cervus size	medium mammal	3,880	46%		3,632	48%	
Canis/Castor/Lepus size	small mammal	203	2%		190	2%	
Indeterminent fragment	unidentified mammal	3,917	46%		2,688	35%	
I.1.c. Unidentified Mammals		**8,508**	**100%**	**53%**	**7,628**	**100%**	**60%**
Total Larger Mammals (*horse not included)		**11,493**		**72%**	**9,746**		**77%**
I.1.d. Rodents							
Avricola terrestris	water vole	0	0%		39	35%	
Arvicolinae sp.	vole species	73	31%		8	7%	
Microtus arvalis	common vole	0	0%		7	6%	
Microtus sp.	*Microtus* genus	0	0%		16	15%	
Cricetus cricetus	European hamster	0	0%		31	28%	
Apodemus sylvaticus	wood mouse	0	0%		1	1%	
Apodemus sp.	field mouse	162	69%		8	7%	
Identified Rodents		**235**	**100%**		**110**	**100%**	
Rodentia	unidentified rodents	830			77		

Table 14.7. Comparison of faunal remains from Vésztő-Bikeri and Körösladány-Bikeri *(continued)*

Taxon	Common Names	Vésztő-Bikeri Early Copper Age NISP Totals			Körösladány-Bikeri Early Copper Age NISP Totals		
I.1.e. Insectivores		**N**	**Group %**	**% of Total**	**N**	**Group %**	**% of Total**
Talpa europaea	European mole	2			2		
Micromammalia	unident. micromammals	1			21		
Total Rodents and Insectivores		**1,068**		**7%**	**210**		**2%**
Total Mammals (*horse not included)		**12,561***		**78%**	**9,956**		**79%**
I.2. Fish							
Esox luxius	(northern) pike	0	0%		28	47%	
Silurus glanis	wels catfish	23	66%		9	15%	
Tinca tinca	tench	0	0%		1	2%	
Alburnus alburnus	bleak	0	0%		1	2%	
Cyprinus carpio	common carp	2	6%		0	0%	
Cyprinidae sp.	carp species	9	26%		5	8%	
Rutilus rutilus	roach	1	3%		0	0%	
Percidae sp.	perch	0	0%		15	25%	
Identified Fish		**35**	**100%**		**59**	**100%**	
Pisces	unidentified fish	1,789			1,252		
Total Fish		**1,824**		**12%**	**1,311**		**10%**
I.3. Birds							
Anas platyrhynchos	mallard duck	0	0%		5	6%	
Anser sp.	geese	0	0%		5	6%	
Falconiformes sp.	raptor species	1	5%		0	0%	
Anatidae	duck family	19	95%		72	88%	
Identified Birds		**20**	**100%**		**82**	**100%**	
Aves	unidentified birds	79			166		
Total Birds		**99**		**1%**	**248**		**2%**
I.4. Reptiles							
Emys orbicularis	European pond turtle	55	87%		29	100%	
Serpentes	unidentified snake	8	13%		0	0%	
Identified Reptiles		**63**	**100%**			**100%**	
Reptilia	unidentified reptile	0			168		
Total Reptiles		**63**		**<1%**	**197**		**2%**
I.5. Amphibians							
Pelobates fuscus	common spadefoot				2	7%	
Rana sp.	frog species				24	83%	
Bufo sp.	toad species				3	10%	
Identified Amphibians					**29**	**100%**	
Anura	unidentified frogs and toads	290			317		
Total Amphibians		**290**		**2%**	**346**		**3%**
I.6. Mollusks							
Bivalvia	freshwater clam	1,059	95%		415	77%	
Gastropoda	snails	61	5%		125	23%	
Total Mollusks		**1,120**	**100%**	**7%**	**540**	**100%**	**4%**
Total (*horse not included)		**15,957**		**100%**	**12,598**		**100%**
Unidentified Vertebrates		6,387			157		
Grand Total		**22,344**			**12,755**		

II. NISP and Percentages of Identified Species at Vésztő-Bikeri and Körösladány-Bikeri, Excluding Block 4 at Vésztő-Bikeri					
Taxon	**Common Names**	**Vésztő-Bikeri Early Copper Age NISP Totals**		**Körösladány-Bikeri Early Copper Age NISP Totals**	
		N	**Group %**	**N**	**Group %**
Bos taurus	cattle	634	29%	584	27%
Ovis/Capra	sheep/goat	768	35%	767	36%
Ovis aries	sheep	26	1%	17	1%
Capra hircus	goat	13	1%	6	<1%
Sus domesticus	domestic pig	594	27%	541	25%
Bos primigenius	aurochs	8	<1%	3	<1%
Cervus elaphus	red deer	26	1%	13	1%
Capreolus capreolus	roe deer	20	1%	52	2%
Sus scrofa	wild boar	16	1%	89	4%
Lepus europaeus	brown hare	17	1%	26	1%
Castor fiber	beaver	1	<1%	5	<1%
Sciurus vulgaris	red squirrel	0	0%	1	<1%
Mustela eversmanni	steppe polecat	2	<1%	1	<1%
Emys orbicularis	European pond turtle	55	3%	29	1%
Total Identified Animals		**2,180**	**100%**	**2,134**	**100%**
Total Larger Mammals		**11,493**	**85.7%**	**9,746**	**86.2%**
Total Fish		**1,824**	**13.6%**	**1,311**	**11.6%**
Total Birds		**99**	**0.7%**	**248**	**2.2%**
Total NISP		**13,416**	**100%**	**11,305**	**100%**

Notes: The percentage of group NISP for each species in each group (such as domesticated mammals or wild mammals) is listed, along with the percentage of the total NISP for each group. Dogs, rodents, unidentified reptiles, amphibians, snails, and unidentified vertebrates are not included in the group totals. *Table by Amy Nicodemus, Zsófia Eszter Kovács, and Richard W. Yerkes.*

at Körösladány-Bikeri, since none of the ring midden at that village was excavated. If the NISP of domesticated animals at the two sites from all excavated contexts is combined, the average for cattle would be 36 percent of the NISP, while sheep/goats would be 37 percent and pigs would be 27 percent.

Secondary products of domestication were introduced during the Neolithic and the Copper Age in southeastern Europe. The earliest dates on the continent for dairying, with goats, sheep, or cattle, range from 5500 to 3500 cal BC. Evidence for the earliest use of animal traction is from around 5500 to 4500 cal BC, while wooly sheep may not have replaced hairy sheep (and enhanced wool textile production) until 3500 cal BC (Bakker et al. 1999; Bogucki 1986, 1993; Craig et al. 2005; Halstead and Isaakidou 2011; Isaakidou 2011; McCormick 1992; Sherratt 1983b). Regarding the Bikeri sites, livestock age profiles from Vésztő-Bikeri seem to indicate a more meat-focused animal economy at that settlement, with milk, labor, and fiber from cattle and ovicaprines serving as supplemental resources. The age profiles from Körösladány-Bikeri suggest that more secondary products from sheep, goats, and cattle may have been extracted at this more recent Tiszapolgár settlement. Loom weights and spindle whorls are indicative of textile production at both villages (see Chapter 13, this volume), and residue analysis of ceramic vessels suggests the more regular use of milk products at Körösladány-Bikeri than at Vésztő-Bikeri (see Chapter 10, this volume). Nonetheless, the overall results from faunal analysis indicate a limited use of secondary products of domestication at both sites. In contrast to other domesticated animals, almost all the pigs from the Bikeri villages were killed when they were young.

Animal remains were not uniformly distributed in these two settlements. Elements from larger-bodied species (especially cattle) and bulkier body parts were more common in the outer ring midden at Vésztő-Bikeri and in the fill of the surrounding palisades and ditches of the enclosures at both sites than they were in cultural layers of the longhouses at Vésztő-Bikeri or in the centrally located pits at both sites. The remains of small animals were more common in the central habitation areas at both Vésztő-Bikeri and Körösladány-Bikeri. Low-utility body parts from livestock were underrepresented in the faunal samples from both Early Copper Age sites, suggesting that some butchering waste was discarded outside the settlement or that the lower dry limb and terminal bones were used to make bone tools that were curated and removed from the sites. There were no significant differences in butchery practices for the domesticated species.

Conclusions

Based on our findings, domesticated animal exploitation strategies appear to have been generalized, risk-minimizing systems, with no real emphasis on particular species or animal products in the Körös region during the Early Copper Age. Our evidence indicates that raising livestock was more important than hunting, fishing, and trapping for the villagers at the Vésztő-Bikeri and Körösladány-Bikeri sites, but those activities did contribute to their diet and their economy. Although more meat came from the larger domesticated cattle, sheep, and goats, domesticated pigs also were very important. Wild animals were a small but significant complement to subsistence, providing meat and fish protein and other raw materials, such as fur, hides, antlers, and sinew. Hunting was focused on large game, while birds and reptiles were less important. Although a large number of freshwater mussels were recovered at the Bikeri sites, they likely were not an important part of the Early Copper Age diet.

The ratio of domesticated to wild mammals and the relative abundance of different livestock species at Vésztő-Bikeri and Körösladány-Bikeri revealed two major shifts during the transition from the Late Neolithic to the Early Copper Age. Bartosiewicz (2005) showed that hunting became more important in the Late Neolithic period and that the number of cattle in domesticated faunal assemblages increased (when compared to Middle Neolithic sites). In the Early Copper Age villages at Vésztő-Bikeri and Körösladány-Bikeri, one of these trends was reversed; hunting declined, but the proportion of cattle remains in the domesticated faunal assemblages may have decreased slightly or remained the same. This contradicts Bökönyi's (1974) argument for a shift to a greater reliance on cattle herding across the Great Hungarian Plain during the Early Copper Age. There is no evidence for major environmental or climatic changes, or any significant migrations of new groups onto the Great Hungarian Plain during the Neolithic–Copper Age transition (see Chapters 1, 2, and 17, this volume). Modifications in animal husbandry practices were slight, and not in response to those factors. Instead, shifts in diet and economy during the Early Copper Age seem to have been the result of changes in settlement patterns, household organization, and control of animal and human labor. Farmers and herders abandoned nucleated tells and large flat settlements and dispersed to smaller, self-sufficient habitations at the end of the Neolithic, but mixed herding of cattle, sheep, goats, and pigs persisted, and the Copper Age villagers did not become mobile pastoralists (Giblin and Yerkes 2016; Gyucha 2015; Gyucha et al. 2004; Parkinson 2002, 2006a; Parkinson et al. 2004b; Yerkes et al. 2009).

Chapter 15

The Floral Assemblages

Richard W. Yerkes, Attila Gyucha, and Kimberly Kasper

This is the first archaeobotanical study of systematically collected samples from Tiszapolgár settlement sites on the Great Hungarian Plain. Macrobotanical remains from Vésztő-Bikeri and Körösladány-Bikeri were collected and identified between 2000 and 2006. In this chapter, we discuss the methodological parameters of the macrobotanical recovery methods and also dive into archaeological interpretations around the plant-based cultivation, gathering, processing, and consumption practices of the Early Copper Age villagers. These types of data also are helpful in making inferences about the surrounding ancient environment and settlement use during the period.

Recovery and Analytical Methods

The macrobotanical materials from Vésztő-Bikeri and Körösladány-Bikeri were recovered from bulk soil samples processed with a modified SMAP flotation system set up at the modern canal of the Dió Creek, located between the two sites (Figure 15.1; see Watson 1976). Sampling methods varied, but as a general rule we attempted to acquire bucket-size samples from all secure Early Copper Age contexts (that is, not from the plowzone or clearly mixed or disturbed excavation units). Larger samples were collected from features, and these were given priority for processing and identification. In general, composite/pinch sampling was employed, and small quantities of soil collected throughout an excavation unit were combined in one sample (Kasper 2003; Pearsall 2000:69). The soil samples from both sites were floated, sorted, and identified by Kimberly Kasper.

Taphonomic processes associated with the climate, soil, and hydrology of the Körös region, as well as the human activities performed at the sites, affected the preservation of organic materials, as is typical at other Neolithic to Bronze Age sites (Bogaard et al. 2007; Gyulai 2010; Sági and Füzes 1966). In addition to charred macro-remains, desiccated finds also were present in the flotation samples. To sort and identify the botanical remains present, the light and heavy fraction samples were separated into splits of four sizes (0.5 cm, 1 cm, 2 cm, and 4 cm; see Kasper 2003; Pearsall 2000:102). Each split was examined independently, with the last two splits (0.5 cm and 1 cm) sorted under a stereoscopic microscope. All charred remains (wood charcoal, fruit pits, grain, weed seeds, and other identifiable plant materials) were removed from the light or heavy fractions and placed in plastic vials. Often identifications were made during the sorting process, but the vast majority of the botanical remains were identified systematically per sample after the initial hand sorting from the heavy/light fraction matrix.

To classify and identify the botanical remains to family, genus, and/or species level, morphological characteristics

Figure 15.1. Modified SMAP flotation system at the modern irrigation canal of the Dió Creek paleomeander between Vésztő-Bikeri and Körösladány-Bikeri. *Figure by William A. Parkinson.*

(such as color, size, and surface patterning) and longitudinal and cross-sections were examined (Kasper 2003). Identifications to different taphonomic levels were difficult because large quantities of the botanical materials were vitrified and distorted. Multiple comparative collections were utilized to help classify the remains, including those at University of Alabama in Birmingham and University of Massachusetts, Amherst. Standard published works with graphic genus and species detail also were utilized (Blamey and Blamey 1984; Csapody 1982; Davis 1993; Hanf 1990; Schoch et al. 1988).

During classification, each identifiable whole charred seed and identifiable charred seed fragment with an embryo (including cereal fragments) was counted as one whole seed. An incomplete charred seed fragment without an embryo was counted as a whole seed only if it was the only fragment of a particular species in a sample (Kasper 2003). Each spikelet fork was calculated as one glume base. If the preservation of the charred seed was incomplete and highly fragmented, the seed fragment was classified as indeterminate or unidentifiable (Kasper 2009; Pearsall 2000; Renfrew 1973; Zohary and Hopf 2000). To standardize the charred botanical remains data, the total number of charred plant remains per sample was divided by the amount of soil sampled and floated. This process of standardization provided a density value that was useful for further feature and content analysis of each excavation unit and its associated levels (Tables 15.1–15.2).

Overview of the Vésztő-Bikeri and Körösladány-Bikeri Macrobotanical Assemblages

At Vésztő-Bikeri, 4,716 liters of soil samples from Early Copper Age contexts were floated and analyzed (Table 15.1). Of the total of 528 recovered floral remains, 418 specimens (79 percent) could be identified to species, genus, or family. The taxon for 24 seeds (5 percent) could not be determined, and 86 seeds or plant fragments (16 percent) could not be identified. Eight seeds and plant fragments were recovered from the fill of two intrusive burials dating to the Hungarian Conquest period (ninth to tenth century AD; see Chapters 7 and 16, this volume). These remains may have derived from Early Copper Age sediments that were redeposited when the graves were filled in, but they were not included in the totals for Early Copper Age occupation at Vésztő-Bikeri.

From the Early Copper Age contexts of the Körösladány-Bikeri site, 886 liters of soil were floated and 689 floral remains were found (Table 15.2). This is a much higher rate than at Vésztő-Bikeri, where floating nearly 5,000 liters resulted in about 500 floral remains. This difference in deposition, recovery, and/or preservation between the two sites may be related to cultural practices but more likely is a result of post-depositional conditions. Of these remains, 425 specimens (62 percent) could be identified to species, genus, or family. Specific classification of seven seeds (1 percent) was not possible, and 257 seeds or plant fragments (37 percent) could not be identified. Features dating to the Late Bronze Age (circa 1300–900 cal BC) and Sarmatian period (second to fourth century AD) at the site are not included in the current study.

Identified Plants from the Bikeri Sites

Identification of the seeds from the Bikeri sites is discussed in detail in Kasper (2003) and is summarized here.

Cereals

Barley

While 37 seeds from Vésztő-Bikeri were classified as hulled barley (*Hordeum vulgare*; Figure 15.2A), one hulled barley seed was found in the samples from Körösladány-Bikeri (Tables 15.1–15.2). Four naked barley seeds (*Hordeum vulgare* var. *nudum*) were recovered only at Körösladány-Bikeri. Additionally, 28 seeds and nine fragments were classified as indeterminate barley (*Hordeum* sp.) from Körösladány-Bikeri, and 17 indeterminate fragments were revealed from Vésztő-Bikeri. Both hulled and naked barley were grown in the Carpathian Basin from the Early Neolithic onward, but the hulled variation occurs more commonly in Neolithic and Copper Age assemblages (Gyulai 2005, 2010; Reed 2012).

Wheat

Twelve seeds and two rachises of emmer wheat (*Triticum dicoccum*) were identified in samples from Vésztő-Bikeri, but no emmer wheat remains were found at Körösladány-Bikeri (Tables 15.1–15.2). Einkorn wheat (*Triticum monococcum*) was uncommon at the Bikeri sites: only four einkorn seeds were found at Vésztő-Bikeri, and a single einkorn rachis was recovered at Körösladány-Bikeri (Tables 15.1–15.2).

While the caryopses or seeds of bread wheat (*Triticum aestivum*; Figure 15.2B) are similar to those of emmer (Renfrew 1973:60; Zohary and Hopf 2000:52), the width of these seeds is different. The six caryopses in the flotation samples from Vésztő-Bikeri and the three specimens from Körösladány-Bikeri are in the bread wheat size range.

Sixty seeds, nine rachises, and 41 plant fragments from Vésztő-Bikeri and 12 seeds and one rachis from Körösladány-Bikeri could be identified only as wheat (*Triticum* sp.). A total of 28 seeds and 110 fragments from Vésztő-Bikeri and 183 fragments from Körösladány-Bikeri could be either barley or wheat (*Hordeum* sp./*Triticum* sp.). Two seeds from Vésztő-Bikeri and 19 seeds and one internode from Körösladány-Bikeri were classified as indeterminate cereals (*Poaceae* spp.).

Similar to barley, einkorn wheat and emmer wheat arrived with the earliest Neolithic migratory groups in the Balkans and the Carpathian Basin, and these two cereals became the most important staple crops for prehistoric communities for several millennia (Filipović and Obradović 2013; Gyulai 2005; van Zeist 2001–2002). In Hungary, emmer wheat and barley occur in nearly equal frequency at Middle and Late Neolithic sites (Gyulai 2010). The sole analyzed Early Copper Age Tiszapolgár floral assemblage on the Great Hungarian Plain was recovered from a single vessel at Battonya-Vertán, located about 75 km south of the Bikeri sites along a paleomeander of the Maros River. The vessel contained charred einkorn and emmer wheat seeds (Goldman and Szénászky 2012). The remains of these two species also constituted the majority of the nearly 2,200 macrobotanical finds from the Early Copper Age layers of the Uivar tell in the Romanian Banat (Fischer and Rösch 2004).

In contrast to einkorn and emmer wheat, bread wheat is found less frequently at Neolithic sites in the Carpathian Basin and the Balkans, and this plant either was grown separately and played only a supplementary role in the diet or it was inter-cropped with other cereals (Borojević 2006; Filipović and Tasić 2012; Gyulai 2010). The seeds from the Bikeri sites are the first bread wheat remains recovered from Tiszapolgár contexts on the Great Hungarian Plain. As in the case of other wheat species, the rachis remains in the assemblage, which are removed in the initial phases of processing, indicate the local production and processing of bread wheat.

Evidence from prehistoric sites in the Carpathian Basin suggests that the various barley and wheat species might have been sown both in the fall and spring, with barley grown more commonly in the summer (Bogaard et al. 2007; Borojević 2006; Gyulai 2010). As opposed to wheat, barley can withstand poor soil quality and droughts. In addition to being used as food for humans, wheat and barley also can be utilized as animal fodder and for alcoholic beverage production. Impressions of their straw and chaff are found commonly in the burned pieces of wattle-and-daub structures at prehistoric sites, which indicates the importance of the by-products of these cereals as construction materials.

Common millet

The wide, shallow embryo depressions on the 21 seeds of common millet (*Panicum miliaceum*) from Vésztő-Bikeri and the two seeds from Körösladány-Bikeri distinguish them from the seeds of wild millets (Tables 15.1–15.2). One millet seed from Vésztő-Bikeri could be either domestic or wild.

Common millet was present in the Körös region as early as the sixth millennium BC (Bogaard et al. 2007). Yet, because the remains of this species are rare in Neolithic contexts (Füzes 1990; Gyulai 2005, 2010; Reed 2012; van Zeist 2001–2002), researchers suggest that millet occurred as a weed intrusive among other domesticates across southeastern and central Europe during this period (Kreuz et al. 2005; van Zeist 1975; Walker and Bogaard 2011). This spring-sown cereal tolerates extreme weather and soil conditions, and produces reliable yields even in

Table 15.1. Macrobotanical remains recovered from Vésztő-Bikeri

		Early Copper Age Contexts								Hungarian Conquest Period Burials
		Longhouse-Related Contexts	Bell-Shaped Pit	Kilns or Ovens	Palisade and Ditches	Other Pits	Burials	Cultural Layer	Vésztő-Bikeri Total	
Volume of Soil Samples (liters)		2,563	169	355	641.5	154.5	85	748	**4,716**	112
Weight of Heavy Fraction (g)		302,457	30,206	122,094	48,616	18,833	9,401	68,232	**599,839**	7,798
Weight of Light Fraction (g)		2,379	224	382	238	224	76	762	**4,285**	87
Taxon	**Common Name**									
I. Domesticates										
Hordeum vulgare	hulled barley	25		5			1	6	**37**	
Hordeum sp. fragments	barley	10		2	1	3		1	**17**	
Hordeum sp./*Triticum* sp.	barley or wheat	19		2	3		2	2	**28**	
Hordeum sp./*Triticum* sp. fragments	barley or wheat	68	4	19	6		3	10	**110**	3
Triticum aestivum	bread wheat	6							**6**	
Triticum dicoccum	emmer wheat	5	1	2	2			2	**12**	
Triticum dicoccum rachis	emmer wheat	1		1					**2**	
Triticum monococcum	einkorn wheat	2		1				1	**4**	
Triticum sp.	wheat	35		20	3			2	**60**	
Triticum sp. rachis	wheat	9							**9**	
Triticum sp. fragments	wheat	29		8		2	1	1	**41**	
Panicum miliaceum	common millet	8		10	2			1	**21**	
cf. *Panicum miliaceum*	common millet?	1							**1**	1
Poaceae spp.	indeterminate cereal	1				1			**2**	
Lathyrus sativus	grass pea			1					**1**	
Cicer arietinum	chickpea							1	**1**	
Lens culinaris	lentil	2			1				**3**	
Pisum spp.	peas			1				1	**2**	
Pisum spp. fragments	peas	2							**2**	
Total Domesticates		**223**	**5**	**72**	**18**	**6**	**7**	**28**	**359**	**4**
Number of domesticate specimens per liter of soil		*0.09*	*0.03*	*0.20*	*0.03*	*0.04*	*0.08*	*0.04*	**0.08**	*0.04*
Carex sp.	sedge			1					**1**	
Chenopodium sp.	goosefoot or fat hen	16		2	1			1	**20**	
Galium sp.	bedstraw or cleavers	3		1	1	1			**6**	1
Polygonum sp.	knotweed	5	3	5				1	**14**	
Total Weeds		**24**	**3**	**9**	**2**	**1**	**0**	**2**	**41**	**1**
Number of weed specimens per liter of soil		*0.009*	*0.018*	*0.025*	*0.003*	*0.006*	*0.000*	*0.003*	**0.009**	*0.009*

		Early Copper Age Contexts								Hungarian Conquest Period Burials
		Longhouse-Related Contexts	Bell-Shaped Pit	Kilns or Ovens	Palisade and Ditches	Other Pits	Burials	Cultural Layer	Vésztő-Bikeri Total	
Cornus mas	Cornelian cherry	6						2	**8**	
Corylus sp. fragments	hazelnut	3							**3**	
Frageria vesca	wild strawberry	2						1	**3**	
Prunus sp.	wild plum or cherry	2							**2**	
Vitis sp.	wild grape	1	1						**2**	
Total Fruits and Nuts		**14**	**1**	**0**	**0**	**0**	**0**	**3**	**18**	0
Number of fruit and nut specimens per liter of soil		*0.005*	*0.006*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	**0.004**	*0.000*
IV. Other										
Indeterminate seeds		17	2	1	1			3	**24**	
Unidentified seed fragments		12		9	3		1	5	**30**	1
Unidentified plant fragments		19		11	5	1		20	**56**	2
Total Other		**48**	**2**	**21**	**9**	**1**	**1**	**28**	**110**	**3**
Totals for Context		**309**	**11**	**102**	**29**	**8**	**8**	**61**	**528**	**8**
Percentage of Total Floral Remains at Site		**58%**	**2%**	**19%**	**6%**	**1.5%**	**1.5%**	**12%**	**100%**	**N/A**
Total Identified to Species or Genus		**261**	**9**	**81**	**20**	**7**	**7**	**33**	**418**	**5**
Total Number of Specimens per Liter of Soil		**0.12**	**0.07**	**0.29**	**0.05**	**0.05**	**0.09**	**0.08**	**0.11**	**0.07**
Total Number of Identified Specimens per Liter of Soil		**0.10**	**0.05**	**0.23**	**0.03**	**0.05**	**0.08**	**0.04**	**0.09**	**0.04**
Ratio of domesticates to weeds		9 to 1	2 to 1	8 to 1	9 to 1	6 to 1	N/A	14 to 1	**9 to 1**	4 to 1

Table by Kimberly Kasper and Richard W. Yerkes.

bad years. Because common millet is relatively abundant in the Vésztő-Bikeri assemblage, it may have become a more frequently grown staple crop by the Copper Age due to these desirable traits.

Legumes

Legume seeds identified in the flotation samples from Vésztő-Bikeri include three lentils (*Lens culinaris*), one grass pea (*Lathyrus sativus*), one chickpea (*Cicer arietinum*), and one indeterminate pea (*Pisum* spp.; Table 15.1). Two indeterminate pea fragments also were found at the site. The samples from Körösladány-Bikeri contained only one angular bitter vetch seed (*Vicia ervilia*) and six large, indeterminate legume plant fragments (Table 15.2).

Lentil, grass pea, and chickpea were part of the "Neolithic package" in Europe (Bailey 2000; Zohary 1996). Lentils and grass peas were grown in the Carpathian Basin throughout the Neolithic (Fischer and Rösch 2004; Hartyányi 1988–1989; Sümegi et al. 2002), but chickpea remains have not been found north of Greece and Bulgaria prior to the Bronze Age (Gyulai 2010; Reed 2012). Thus the seed from Vésztő-Bikeri is the earliest evidence for chickpea cultivation in the Carpathian Basin. In addition, bitter vetch may have been cultivated only from the later Neolithic onward in southeastern Europe (Filipović and Obradović 2013).

Legume pods are more fragile and less resistant to fire than cereal grains (Filipović and Tasić 2012:11), which might explain their low frequency in archaeobotanical

Table 15.2. Macrobotanical remains recovered from Early Copper Age contexts at Körösladány-Bikeri

		Wall Trench	Bell-Shaped Pits	Well	Middle Enclosure Ditch	Other Pit	Burial	Körösladány-Bikeri Total
Volume of Soil Samples (liters)		107	510	45	180	19	25	**886**
Weight of Heavy Fraction (g)		12,714	134,611	4,906	20,047	2,750	638	**175,666**
Weight of Light Fraction (g)		4	792	4	10	15	4	**829**
Taxon	**Common Name**							
I. Domesticates								
Hordeum vulgare	hulled barley		1					**1**
Hordeum vulgare	naked barley		3		1			**4**
Hordeum sp.	barley		27	1				**28**
Hordeum sp. fragments	barley		9					**9**
Hordeum sp./*Triticum* sp. fragments	barley or wheat		167	12		1	3	**183**
Triticum aestivum	bread wheat		2			1		**3**
Triticum monococcum	einkorn wheat				1			**1**
Triticum sp.	wheat		11			1		**12**
Triticum sp. rachis	wheat		1					**1**
Panicum miliaceum	common millet		2					**2**
Poaceae spp.	indeterminate cereal		5	3	10	1		**19**
Cereal internode	cereal		1					**1**
Vicia ervilia	bitter vetch		1					**1**
Large legume fragments	legume		4	1	1			**6**
Total Domesticates		**0**	**234**	**17**	**13**	**4**	**3**	**271**
Number of domesticate specimens per liter of soil		*0.00*	*0.46*	*0.38*	*0.07*	*0.21*	*0.12*	**0.31**
II. Weeds								
Brassica sp.	wild cabbage or mustard				1			**1**
Chenopodium album	fat hen	6	112	1	5	1		**125**
Chenopodium hybridum	goosefoot				1			**1**
Chenopodium sp.	goosefoot or fat hen	1			1			**2**
Galium aparine	stickywilly		7					**7**
Rumex sp.	dock		1					**1**
Silene sp.	campion		3		2			**5**
Small-seeded legume	legume	1	2	1				**4**
Total Weeds		**8**	**125**	**2**	**10**	**1**	**0**	**146**
Number of weed specimens per liter of soil		*0.07*	*0.25*	*0.04*	*0.06*	*0.05*	*0.00*	**0.16**
III. Fruits and Nuts								
Cornus mas	Cornelian cherry			1				**1**
Corylus sp. fragments	hazelnut		1					**1**
Sambucus sp.	elderberry		2					**2**
Trapa natans	water chestnut		1					**1**
Nutshell fragments	indeterminate nut		2				1	**3**
Total Fruits and Nuts		**0**	**6**	**1**	**0**	**0**	**1**	**8**
Number of fruit and nut specimens per liter of soil		*0.00*	*0.01*	*0.02*	*0.00*	*0.00*	*0.04*	**0.01**

	Wall Trench	Bell-Shaped Pits	Well	Middle Enclosure Ditch	Other Pit	Burial	Körösladány-Bikeri Total
IV. Other							
Indeterminate seeds		7					**7**
Unidentified seed fragments	1	13	1	5			**20**
Unidentified plant fragments	3	228			5	1	**237**
Total Other	**4**	**248**	**1**	**5**	**5**	**1**	**264**
Total for Context	**12**	**613**	**21**	**28**	**10**	**5**	**689**
Percentage of Total Floral Remains at Site	**1.5%**	**89%**	**3%**	**4%**	**1.5%**	**1%**	**100%**
Total Identified to Species or Genus	**8**	**365**	**20**	**23**	**5**	**4**	**425**
Total Number of Specimens per Liter of Soil	**0.11**	**1.20**	**0.47**	**0.16**	**0.53**	**0.20**	**0.78**
Total Number of Identified Specimens per Liter of Soil	**0.07**	**0.72**	**0.44**	**0.13**	**0.26**	**0.16**	**0.48**
Ratio of domesticates to weeds	N/A	2 to 1	9 to 1	1 to 1	4 to 1	N/A	**2 to 1**

Table by Kimberly Kasper and Richard W. Yerkes.

assemblages. Yet, as the more than 1,500 well-preserved pea seeds recovered from the Late Neolithic site of Berettyóújfalu-Szilhalom—located about 40 km from the Bikeri settlements—illustrate (Gyulai 2010), legume species may have constituted a significant segment in the Neolithic diet on the Great Hungarian Plain.

Legumes are a high-protein staple and may have been grown in permanent garden plots near the houses or in the immediate vicinity of the settlements. Some species, such as grass pea or chickpea, may have been insurance crops, as they tolerate extreme conditions and produce high yields even in years when other crops fail. Because bitter vetch must be processed thoroughly to remove its toxins, some believe it would have been consumed only during times of famine (Zohary and Hopf 2000).

Weeds

A variety of weed remains were recovered from the Bikeri sites, albeit in small numbers. They include plants that grow in arable lands accompanying domesticates (arable weeds) and ruderal species that occur regularly in disturbed and tramped anthropogenic contexts (e.g., ditches, paths, middens). The most abundant *Chenopodium* (goosefoot) seeds in both assemblages are small and round with a pronounced beak (Borojević 1997:137). Oftentimes, *Chenopodium* seeds have unique reticulations that aid in identifying them to species. The majority of the identified *Chenopodium* finds from Körösladány-Bikeri are fat hen seeds (*Chenopodium album*). Additionally, only one goosefoot seed (*Chenopodium hybridum*) was identified in samples from that site. Two seeds from Körösladány-Bikeri and all 20 recovered seeds from Vésztő-Bikeri were in poor condition and could be classified only as indeterminate *Chenopodium* sp. (Tables 15.1–15.2). The various *Chenopodium* sp. weeds are common summer annuals, but they also could have been gathered for human consumption.

Seven seeds from Körösladány-Bikeri were identified as stickywilly (*Galium aparine*), and six bedstraw or cleavers seeds (*Galium* sp.) were recovered from Vésztő-Bikeri (Tables 15.1–15.2). Several *Galium* species, including stickywilly, are regarded as arable weeds of winter cereals (Bogaard 2004). These plants may also have been gathered near the Bikeri sites, and the leaves and stems would have been cooked until edible.

At Vésztő-Bikeri, the 14 identified knotweed specimens (*Polygonum* sp.; Figure 15.2C) are highly fragmented and could not be classified to species. The only other weed seed recovered at Vésztő-Bikeri was a single indeterminate sedge seed (*Carex* sp.). This plant may have been used for construction and basketry. From Körösladány-Bikeri, one wild cabbage or mustard seed (*Brassica* sp.), one dock seed (*Rumex* sp.), five campion seeds (*Silene* sp.), and four small-seeded wild legume seeds also were found. After proper processing, most of these gathered and possibly occasionally cultivated weeds may have been consumed or used as fodder. Several species found at Vésztő-Bikeri and Körösladány-Bikeri, including stickywilly, knotweed, and cleavers, have significant medicinal value as well.

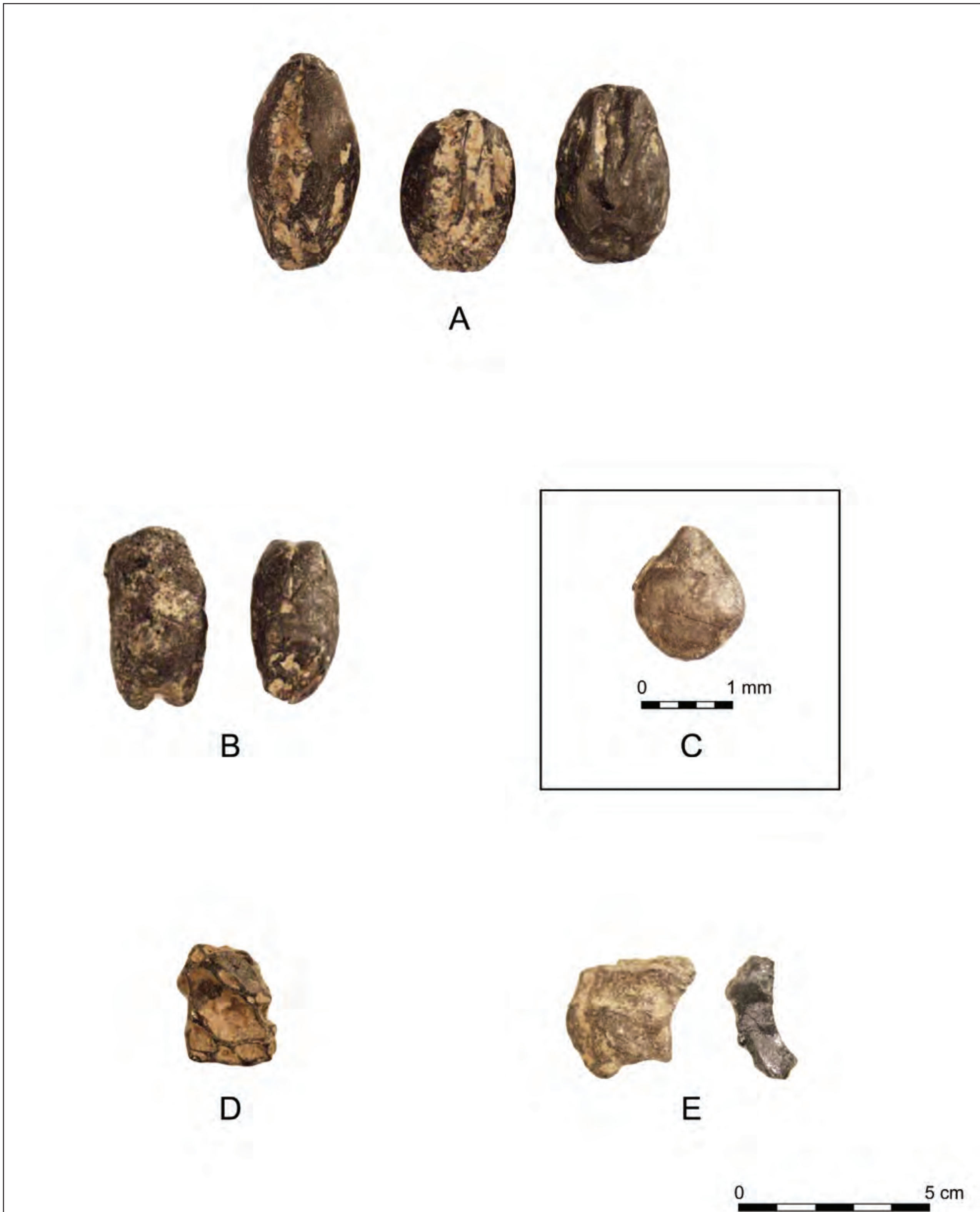


Figure 15.2. Plant remains from Vésztő-Bikeri. A: Hulled barley (*Hordeum vulgare*) seeds from the cultural layer above the floor of the Feature 15 longhouse; B: Bread wheat (*Triticum aestivum*) seeds from the cultural layer above the floor of the Feature 15 longhouse; C: Knotweed (*Polygonum* sp.) seed from the Feature 13 bell-shaped pit; D: Cornelian cherry (*Cornus mas*) seed fragment from the daub layer covering the Feature 4/14 longhouse; E: Wild plum or cherry (*Prunus* sp.) seed fragment from the daub layer covering the Feature 4/14 longhouse. *Figure by Kimberly Kasper.*

Fruits and Nuts

Eight Cornelian cherry seeds (*Cornus mas*; Figure 15.2D) were revealed in the samples from Vésztő-Bikeri, and a single cherry pit was recovered at Körösladány-Bikeri (Tables 15.1–15.2). The two wild plum or cherry pits (*Prunus* sp.; Figure 15.2E) from Vésztő-Bikeri could be distinguished from the Cornelian cherries by the compressed character of the endocarp. Three wild strawberry (*Frageria vesca*) and two wild grape (*Vitis* sp.) seeds also were identified in the samples from Vésztő-Bikeri, whereas two elderberry seeds (*Sambucus* sp.) were found at Körösladány-Bikeri. The elderberry and wild grape seeds are poorly preserved and could not be identified to species.

Three fragments of hazelnut (*Corylus* sp.) were recovered from Vésztő-Bikeri and a single hazelnut fragment was found at Körösladány-Bikeri (Tables 15.1–15.2). One water chestnut seed (*Trapa natans*) came from a sample from Körösladány-Bikeri. Raw, boiled, or roasted water chestnut seeds have been consumed from the Mesolithic to recent times, and they can be ground into flour for making bread as well (Borojević 2009; Filipović and Tasić 2012). Water chestnut is collected from shallow, slow-moving, or still waters, such as cut-off paleomeanders, during late summer or early fall.

Contextual Analysis of the Macrobotanical Remains at the Bikeri Villages

While five times more soil from Early Copper Age contexts was processed at Vésztő-Bikeri than at Körösladány-Bikeri, nearly the same amount of identified plant remains were recovered from both sites (Tables 15.1–15.2). The density of botanical specimens per liter of floated soil at Körösladány-Bikeri is 0.78 for all macrobotanical remains and 0.48 for the identified seeds and plant fragments, while at Vésztő-Bikeri these values are only 0.11 and 0.09, respectively. Contextual analyses permit a better understanding of the causal factors of these remarkable differences between the two Tiszapolgár villages.

Vésztő-Bikeri

The 528 floral remains found at Vésztő-Bikeri were recovered from seven different types of Early Copper Age contexts: (1) longhouse-related features; (2) a bell-shaped

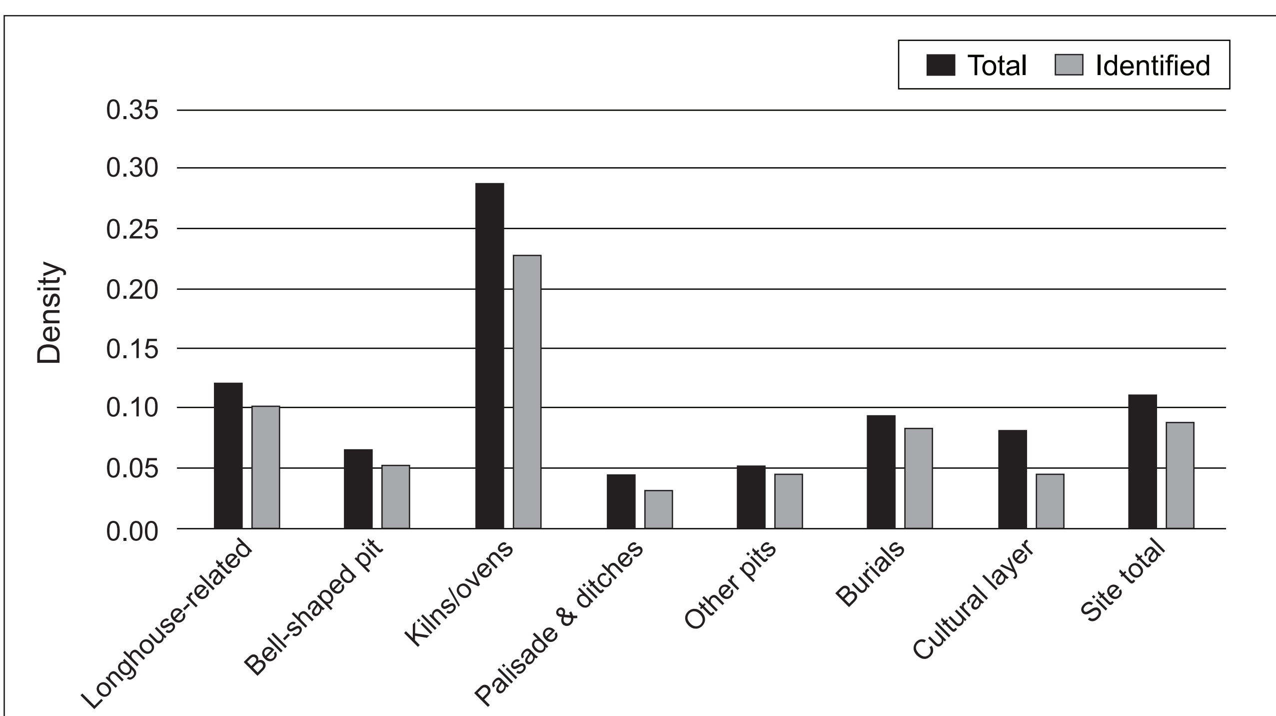


Figure 15.3. Density of total and identified macrobotanical remains at Vésztő-Bikeri (specimens per liter of floated soil). Source: Table 15.1. *Figure by Kimberly Kasper and Richard W. Yerkes.*

pit; (3) kilns or ovens; (4) the palisade and ditches of the enclosure surrounding the site; (5) other pits; (6) burials; and (7) cultural layers without features (Table 15.1; Figure 15.3; see Chapter 7, this volume).

More than half (58 percent) of the macrobotanical materials from the site came from the three sampled longhouse areas (Features 5, 4/14, and 15; Figure 15.4). The remains were recovered from flotation samples taken from several different contexts: the fill of the wall trenches of the structures (Features 26, 28, 29, 78, 86, 123), the fill of postholes in these trenches (Features 24, 30, 31, 72, 91, 92, 94, 97, 102, 107, 111 to 114), a daub concentration above the Feature 28 wall trench (Feature 34), the floor layers of the longhouses, and the layers with cultural materials deposited over the structures after their abandonment. The density of the botanical materials from these features was only 0.12 specimens per liter of floated soil (Figure 15.3). Furthermore, most of these remains are from secondary contexts that are not associated with specific activity areas in or near the longhouses during their use. No hearths or ovens were found in these large structures and no undisturbed storage facilities—such as clay bins or granaries that are commonly found at Late Neolithic sites on the Great Hungarian Plain (e.g., Horváth 1987; Kalicz and Raczky 1984; Medović and Horváth 2011)—were encountered during the excavations. The cluster of ceramics, including several larger ones, in the eastern section of Feature 4/14 (see Chapter 7, this volume) did not produce evidence for their use as grain storage vessels.

Nonetheless, the greatest variety of domesticates, weeds, fruits, and nuts was found in the flotation samples from these longhouse-related contexts at the site (Table 15.1). Remains of hulled barley, emmer wheat, einkorn wheat, bread wheat, and common millet all were present, along with lentil and some indeterminate legumes. The identified weeds include goosefoot, bedstraw or cleavers, and knotweed. Seeds or fragments of Cornelian cherry, wild strawberry, wild plum or cherry, wild grape, and hazelnut also were identified in longhouse-related contexts.

Even though 169 liters of soil from the Feature 13 bell-shaped pit were processed, only 11 seeds or plant fragments were recovered, resulting in a low density of 0.07 specimens per liter of floated soil. The floral materials from this single pit account for only 2 percent of the total macrobotanical remains from Vésztő-Bikeri (Table 15.1; Figures 15.3–15.4). Emmer wheat and barley or wheat fragments, as well as a few knotweed seeds and a wild grape seed, were identified in the samples.

The plant remains from two adjacent kilns or ovens (Features 35 and 105) excavated on top of a filled well

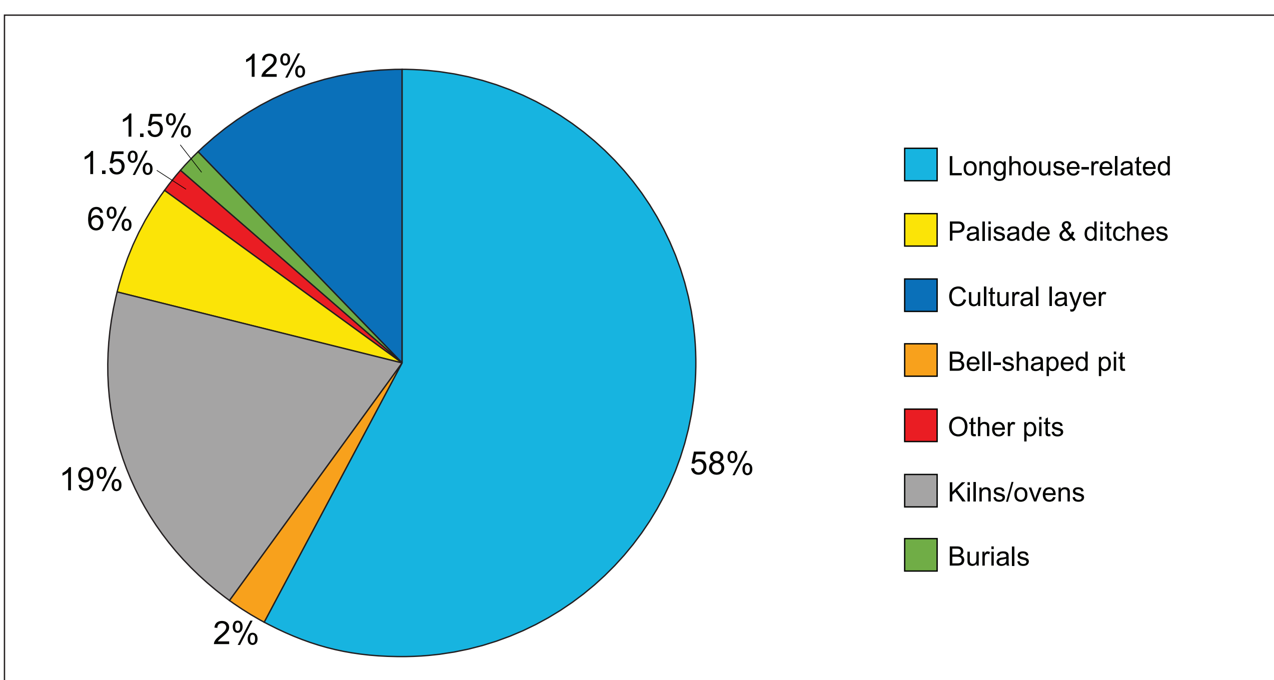


Figure 15.4. Percentage of all recovered macrobotanical remains by context at Vésztő-Bikeri. Source: Table 15.1. *Figure by Kimberly Kasper and Richard W. Yerkes.*

(Feature 151) account for 19 percent of the total at Vésztő-Bikeri. However, the density of the recovered botanical remains—0.29 specimens per liter of floated soil—is more than two times greater than the second-highest value documented in longhouse-related contexts (Table 15.1; Figures 15.3–15.4). In addition to the remains of hulled barley, einkorn and emmer wheat, common millet, and grass pea, each weed taxon identified at the site also derived from the kilns/ovens samples. These features might have been external cooking facilities, and although it is possible that the fill—and thus the recovered plant materials—was redeposited, the relative abundance of cereals may be indicative of their original function. If the latter holds, the presence of non-cereals may suggest that weeds and nuts were processed in these kilns/ovens as well.

The soil samples from the fill of the palisade trench (Feature 88) and the outer ditch (Feature 66) that surrounded Vésztő-Bikeri, and from the fill of the postholes in the palisade trench (Features 80, 101, 117 to 120, 130, 140 to 143) and the line of large postholes just inside the palisade (Features 41, 65, 74, 95, 103, 121), contained 6 percent of the total number of macrobotanical remains recovered at the site. The low density of 0.05 specimens per liter of floated soil from these features is similar to the densities in the bell-shaped pit and other pits (Table 15.1; Figures 15.3–15.4). Seeds of barley and wheat, common millet, and lentil were recovered from these samples, along with goosefoot, bedstraw or cleavers remains, but no nuts or fruits were found.

The macrobotanical remains found in the fill of other pits that were not bell-shaped (Features 69, 96, 100, 109, 129, 137) amount to 1.5 percent of the total for Vésztő-Bikeri (Table 15.1; Figures 15.3–15.4). The density of 0.05 botanical specimens per liter of floated soil is about as high as it is for the bell-shaped pit but much lower than the density in the samples from the kilns/ovens and the longhouse-related contexts. Barley, wheat, and bedstraw or cleavers seeds were recovered from these pits.

Only eight botanical specimens, accounting for 1.5 percent of the total floral remains, were recovered from the samples around the Early Copper Age burials (Features 71 and 85; see Table 15.1; Figures 15.3–15.4). The specimens include hulled barley and wheat seeds, but no weeds, fruits, or nuts were found. The density of botanical specimens is 0.09 per liter of floated soil in these contexts. However, in Feature 71 alone, this value is 0.23 (Kasper 2009:Figure 6-3). Considering the high density relative to other contexts at Vésztő-Bikeri and the fact that only cereal seeds were recovered from this grave, it is likely that the grains were associated with the funerary ritual or were possibly intentionally incorporated into the burial fill.

Twelve percent of the total macrobotanical finds were recovered in samples from cultural layers without features at Vésztő-Bikeri (Table 15.1; Figure 15.4). Hulled barley, emmer wheat, einkorn wheat, and common millet were identified, as well as the only chickpea remain found at the site. Goosefoot and knotweed seeds were present, and Cornelian cherry pits and a wild strawberry seed were recovered from these contexts as well. The density of macrobotanical materials from the sampled cultural layers is 0.08 specimens per liter of soil floated, which is higher than that of the bell-shaped and other pits as well as the enclosure-related features but lower than the values for the kilns/ovens and the longhouse-related features (Figure 15.3).

The ratio of domesticates to weeds for all samples from Vésztő-Bikeri was 9:1 (Table 15.1). The ratio was the same in the flotation samples from the longhouse- and enclosure-related features, nearly the same in the kilns/ovens (8:1), and even higher (14:1) in the cultural layers. Weeds were more abundant in the samples from the bell-shaped pit (3:2) and other pits (6:1). No weeds were identified in the samples from the burials.

Körösladány-Bikeri

At Körösladány-Bikeri, the majority of flotation samples came from six Early Copper Age archaeological contexts: (1) a wall trench; (2) three bell-shaped pits; (3) a well; (4) the middle ditch of the enclosure surrounding the site; (5) a small pit; and (6) two child burials (Table 15.2; Figure 15.5; see Chapter 7 volume).

No longhouse structures were exposed during the excavations at Körösladány-Bikeri. The single wall trench (Feature 29) at the settlement contained only 1.5 percent of the site's total seeds and plant fragments, accounting for a density of 0.11 specimens per liter of floated soil (Table 15.2; Figures 15.5–15.6). Domestic plant remains were not found in this feature. The majority of identified specimens are goosefoot seeds. A small-seeded legume remain also was found.

The floral remains from three bell-shaped pits (Features 5, 10, 35) and from a charcoal-filled posthole (Feature 27) inside one of the bell-shaped pits (Feature 10) account for the vast majority, 89 percent, of the total Early Copper Age macrobotanical finds from the site (Table 15.2; Figure 15.6). The density of materials in these bell-shaped pits also is very high: 1.20 specimens per liter of floated soil (Figure 15.5). Numerous remains of domesticates, such as hulled and naked barley, einkorn and bread wheat, and common millet, as well as a few legume remains, were found. The identified weeds include bitter

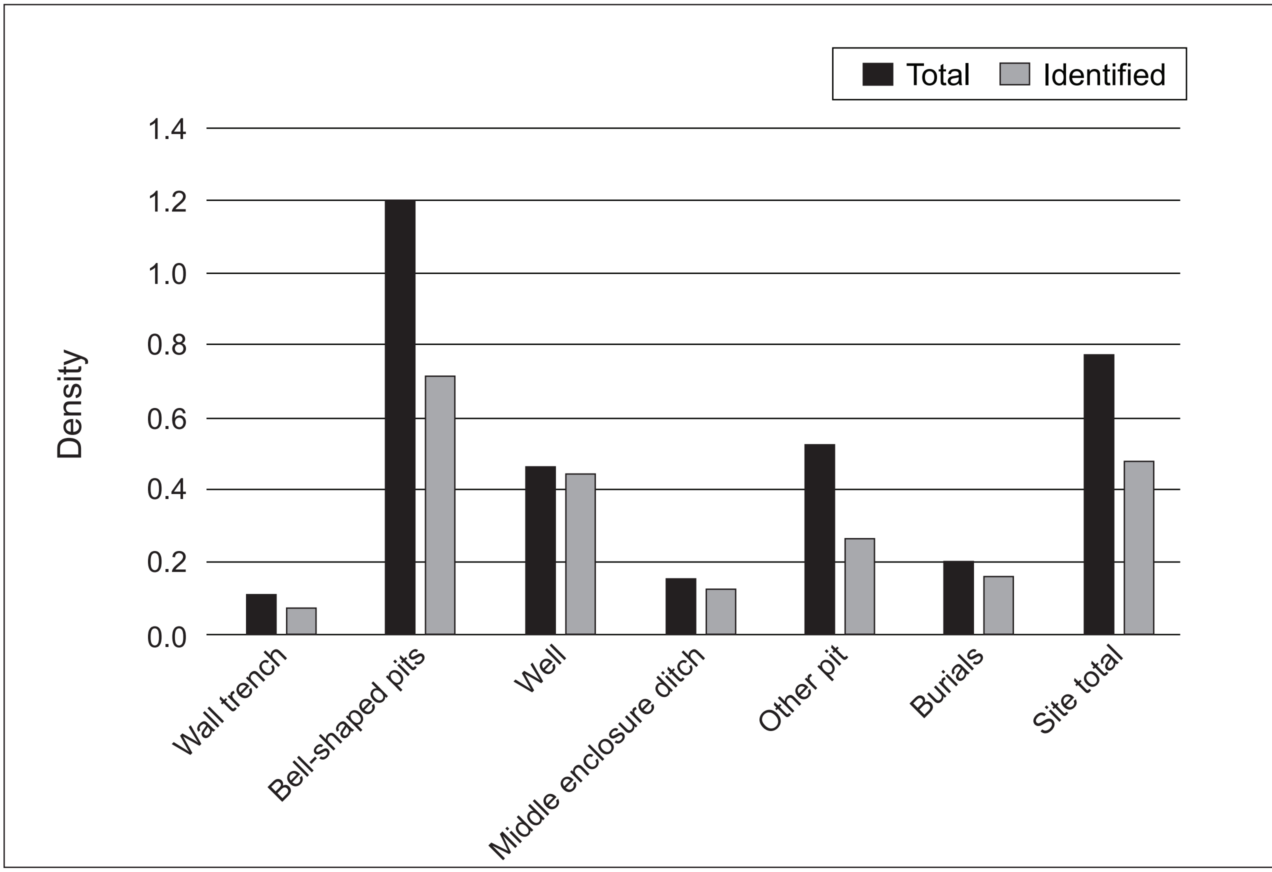


Figure 15.5. Density of total and identified macrobotanical remains at Körösladány-Bikeri (specimens per liter of floated soil). Source: Table 15.2. *Figure by Kimberly Kasper and Richard W. Yerkes.*

vetch, stickywilly, dock, campion, and small-seeded legumes, but fat hen prevails overwhelmingly in these samples. Hazelnut, water chestnut, and elderberry specimens also were recovered from these contexts. Although the fill of the bell-shaped pits may have been largely redeposited, the high number and density of cereals and arable weeds indicate that the botanical finds likely are associated with the original, storage functions of these features.

Samples from a well (Feature 48) on the western edge of Körösladány-Bikeri contained 3 percent of the total macrobotanical remains from the site, yielding a density of 0.47 specimens per liter of floated soil (Table 15.2; Figures 15.5–15.6). This density value is the second highest among the Early Copper Age contexts. Several cereal remains and a large legume, as well as a Cornelian cherry pit, one fat hen, and a small-seeded legume fragment, were found in the flotation samples from the well.

The abundance of botanical remains in the middle ditch of the enclosure (Feature 30) surrounding the Early Copper Age village is 4 percent of the site total, with a density of 0.16 specimens per liter of floated soil (Table 15.2; Figures 15.5–15.6). In addition to some cereal finds, including naked barley and einkorn wheat, a large legume fragment and seeds from fat hen, goosefoot, campion, and wild cabbage or wild mustard were recovered from this context.

In a small pit (Feature 13) that was not bell shaped, the macrobotanical remains accounted for 1.5 percent of the total, and the density was as high as 0.53 specimens per liter of floated soil (Table 15.2; Figures 15.5–15.6). This is the second highest density value at Körösladány-Bikeri. A few cereal seeds, including a bread wheat specimen, and one fat hen seed were found in this feature.

In the samples from the fill of two child graves (Features 11 and 12), 1 percent of the total botanical remains were recovered (Table 15.2; Figure 15.6). As with the middle ditch of the enclosure, the density value is 0.20 specimens per liter of floated soil (Figure 15.5). A small

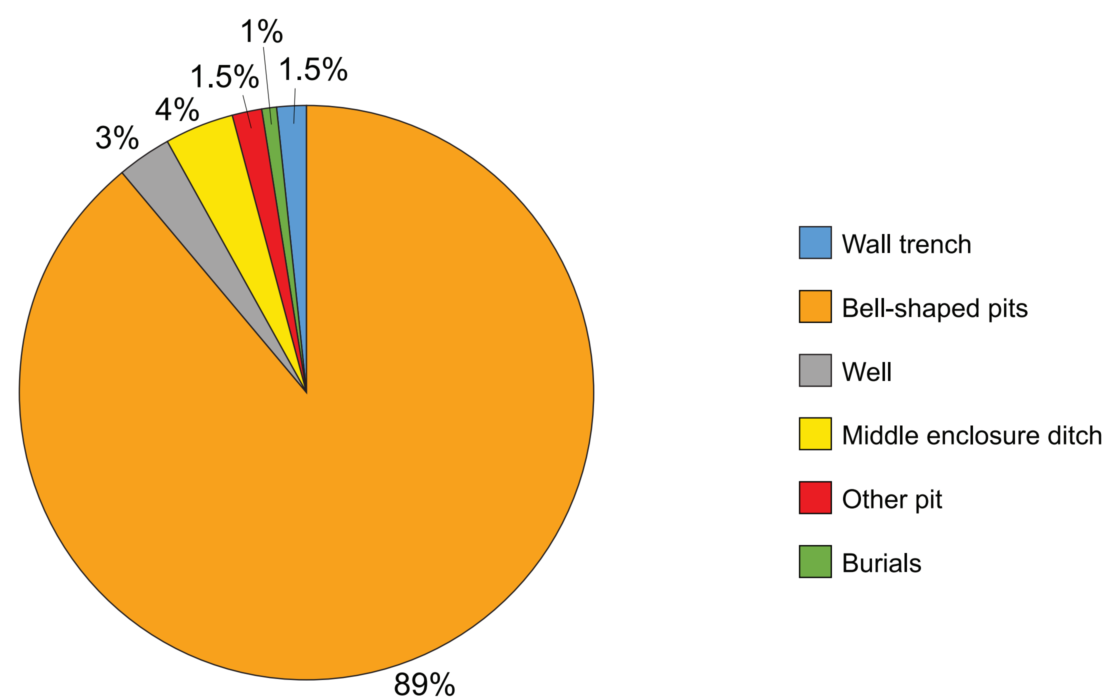


Figure 15.6. Percentage of all recovered macrobotanical remains by context at Körösladány-Bikeri. Source: Table 15.2. *Figure by Kimberly Kasper and Richard W. Yerkes.*

amount of barley or wheat remains and a nutshell fragment were found in these samples.

The ratio of domesticates to weeds for all samples from Körösladány-Bikeri was 2:1 (Table 15.2). In the samples from the bell-shaped pits, the ratio of domesticates to weeds was the same, but this value was greater (4:1) for the other pit feature. The highest value was recorded for the well (9:1). Domesticates and weeds recovered from the middle ditch are represented in equal proportions. No domesticates were identified from the wall trench, and no weeds were found in the burial samples.

Comparing the Results of the Contextual Analyses at the Bikeri Sites

As with other artifact and ecofact studies, the contextual analysis of macrobotanical materials is limited by the post-depositional processes that influenced the spatial distribution of these finds. As a result, the remains frequently are not found in their primary contexts of processing, storage, and utilization. Nevertheless, their recorded spatial patterns may be indicative of site use practices and formation processes, especially when considered in light of the spatial and functional characteristics of features and the distribution of other finds (Kasper 2009).

At the Bikeri settlements, only a few archaeological features contained macrobotanical remains in what we presume to be their original depositional contexts related to the primary use of these features. These exceptional contexts include the kilns/ovens, the Feature 71 burial at Vésztő-Bikeri, the floor layers of the Feature 4/14 longhouse at Vésztő-Bikeri, and the bell-shaped pits at Körösladány-Bikeri. Macrobotanical finds recovered from the fill of other pits, ditches, wall trenches, postholes, other contemporaneous burials, and the cultural layers may have been redeposited during the Early Copper Age. Stratigraphic studies indicate cycles of construction, destruction, and leveling episodes at both villages over the course of their occupation, supporting this assertion (see Chapters 7 and 8, this volume).

The greatest abundance of macrobotanical specimens is from the bell-shaped pits at Körösladány-Bikeri, as well as from the longhouse-related features, kilns/ovens, and cultural layers—located predominantly near the longhouses—at Vésztő-Bikeri. Their density values are high, and nearly 90 percent of the macrobotanical remains recovered from the sites were found in these contexts (see Figures 15.3–15.6). The spatial concentration of domesticates and arable weeds suggests that plant processing, preparation, storage, and consumption occurred predominantly in the central sections of the villages, in and close to the domestic structures.

Significant differences can be identified in the relationship between feature types and floral remains from the two Early Copper Age sites. Bell-shaped pits likely had a similar food storage function at both sites. Yet the abundance of macrobotanical finds in these features is much higher at Körösladány-Bikeri than at Vésztő-Bikeri (1.20 versus 0.07 specimens per liter of floated soil). This profound difference is correlated with the differential frequencies of domesticates in the bell-shaped features at the two sites, with 0.46 botanical specimens per liter at Körösladány-Bikeri and 0.03 at Vésztő-Bikeri (see Tables 15.1–15.2). This raises the possibility that the pits at Körösladány-Bikeri contained more grain seeds during their primary storage uses. Alternatively, the Vésztő-Bikeri feature may have been more completely emptied out and the grain fully utilized before it was filled in.

In terms of plant species, hulled and naked barley, einkorn and bread wheat, common millet, and legume remains were identified in the pit samples from Körösladány-Bikeri. In contrast to Vésztő-Bikeri, no emmer wheat or lentils were present in any flotation samples from the site. The bell-shaped pits of Körösladány-Bikeri contained a wide selection of weed species. Stickywilly, dock, campion, and small-seeded legumes were not recovered from any contexts at Vésztő-Bikeri. Bedstraw or cleavers, sedge, and knotweeds were not present in the bell-shaped pit samples at Körösladány-Bikeri. Nutshells, seeds, and fragments of Cornelian cherry, hazelnut, elderberry, and water chestnut were identified in the samples from the bell-shaped pits at Körösladány-Bikeri. The latter two were not recovered at Vésztő-Bikeri. Wild strawberry and wild cherry remains were not recovered from Körösladány-Bikeri.

Longhouse-related features yielded the second-highest density of macrobotanical remains at Vésztő-Bikeri. By contrast, the single excavated feature possibly associated with a building at Körösladány-Bikeri, a wall trench, produced the lowest density of floral specimens at that site. Whereas the longhouse-related features at Vésztő-Bikeri produced a large quantity and broad selection of domesticates and other taxa, only a few weed fragments were recovered from this wall trench at Körösladány-Bikeri. This suggests that longhouse areas at Vésztő-Bikeri were used for food processing, preparation, and consumption during the occupation at that site. By contrast, the fill of the wall trench at Körösladány-Bikeri is associated with the initial occupation phase of that site, and it does not seem to have been exposed during the later occupation phase.

The lowest density of macrobotanical specimens at Vésztő-Bikeri occurs in the various features of the enclosure system, and the samples from the middle ditch yielded the second-lowest density value at Körösladány-Bikeri. At Vésztő-Bikeri, predominantly domesticates were found in the fill of these features, whereas at Körösladány-Bikeri, the abundance of domesticates and weed remains was nearly identical. In the Early Copper Age burials, a medium density of macrobotanical remains was recorded at both sites. The identified specimens in these contexts are exclusively from cereals at Vésztő-Bikeri and nearly exclusively from cereals—except a nutshell fragment—at Körösladány-Bikeri. The remains may have come from the cultural layer that was used to fill the burial pits. However, if the cereal seeds from Feature 71 at Vésztő-Bikeri are associated with their deliberate placement in the grave as part of the ritual (see Chapter 16, this volume), they may indicate some differential treatment of the dead at the two sites.

Plant Production, Exploitation, and Consumption at the Bikeri Sites

As with other organic materials, the environmental conditions on the Great Hungarian Plain do not favor the preservation of botanical remains. Natural taphonomic processes related to climate, hydrology, and soil characteristics may account for the very low quantity of macrobotanical remains from the Bikeri settlements. As at other prehistoric sites in the broader region (e.g., Filipović and Tasić 2012; Goldman and Szénászky 2012), carbonized as well as mineralized remains, which are more resistant to biodegradation, were recovered from the flotation samples. Charring might have occurred either by chance during fuel burning, food preparation, and storage cleaning or as a result of the accidental or deliberate burning of structures (Filipović and Obradović 2013).

The high degree of fragmentation in the macrobotanical assemblages—at Vésztő-Bikeri, 21 percent of the specimens could not be identified to species, genus, or family, and this value is 38 percent at Körösladány-Bikeri—indicates that other factors must have influenced the preservation of the remains at the settlements. These factors may incorporate cultural practices, including methods of grain processing and food preparation. Subsequent construction episodes during and after the Early Copper Age, as well as natural processes such as bioturbation, flooding, and erosion, all likely contributed to the fragmentation and destruction of floral materials in Early Copper Age features and cultural layers.

The Bikeri macrobotanical finds indicate the consumption of a variety of plants at the settlements, including domesticates, nuts, and wild species. The diverse composition of the assemblages is indicative of subsistence strategies designed to minimize the impact of environmental risks. Recurrent flooding, rapid changes in the level of the water table, and periodic droughts all are likely to have occurred during the Early Copper Age occupation of the Bikeri sites (see Chapter 2, this volume). Along with the topographic and soil characteristics, these factors resulted in a mosaic-like, micro-locally heterogeneous landscape, with alternating, highly diverse ecozones of natural and anthropogenic habitats. These habitats served as ecological niches and offered an array of different opportunities for farming and gathering of plants. As a result, the botanical records from the Bikeri sites indicate the community's culturally and environmentally determined choices, and represent the spectrum of plants available in the ancient landscape.

The cereal fields, as well as some of the pastures, likely were situated at higher elevations around the Bikeri sites, which were less exposed to periodic floods. The most abundant domesticates (barley, emmer, and einkorn wheat) were the same cereals that have been found at many Neolithic and Copper Age sites across the Balkans and throughout the Carpathian Basin (Bogaard 2001; Bogaard et al. 2007; Borojević 2006; Gyulai 2010; Hartyányi and Nováki 1975; Hubbard 1980; McLaren and Hubbard 1990). In addition to grinding stones and chipped stones with sickle gloss (see Chapters 12 and 13, this volume), the rachis fragments in the Bikeri floral assemblages confirm the local production and processing of these cereals. Legumes likely were grown in garden plots within or immediately adjacent to the villages. The permanently wet areas were home to marsh vegetation, such as reeds and rushes, while the temporarily wet, occasionally inundated lower zones in the landscape would have accommodated a variety of wild grass species. Indicator species of the wet landscape in the Bikeri assemblages include dock, sedge, and campion. In these wetter fields, the residents also would have grazed some of the livestock—pigs in particular—and would have gathered various plants for food, medicine, fodder, and construction. Some of the weeds, such as goosefoot and knotweed, also may have been cultivated (cf. Bogaard 2004; Bogaard et al. 2007) and served as insurance crops. A few gathered species in the assemblages, such as water chestnut, could have been used for a similar purpose. The presence of water chestnut from Körösladány-Bikeri indicates an inactive paleomeander, likely the Dió Creek, near the settlements. Groups of trees and patches of woods—exploited for fuel, tool making, or construction materials—also were present in the Early Copper Age landscape. In addition to the identified fruit tree and shrub species from forest edges, forest undergrowth, and clearings, riparian forests composed of willow, poplar, elder, oak, ash, and various shrub communities would have occurred on the floodplains. Oak-based formations likely would have thrived on the alkaline soils in the vicinity of the Bikeri villages.

The remains of both winter (for example, bread wheat and lentils) and spring crops (such as barley, millet, and bitter vetch), as well as arable weeds (such as goosefoot, knotweed, and bedstraw), all of which were recovered at the two sites, provide evidence for the year-round habitation of the Bikeri settlements. The distribution of macrobotanical finds indicates that the processing of plants and food preparation occurred predominantly in the central areas. The outdoor kilns or ovens at Vésztő-Bikeri suggest that cooking was at least partially a collective activity. Bell-shaped pits might have been used as storage facilities for the crops at both sites. Clay boxes, which are regularly found and interpreted as grain bins at settlements of the preceding Late Neolithic period (see above), were not identified at the Bikeri sites. But large ceramic vessels, such as the cluster of pots in the eastern section of the Feature 4/14 longhouse at Vésztő-Bikeri, may have been used for crop storage within the structures. As the wheat and barley seeds in the fill of the Feature 71 burial at Vésztő-Bikeri indicate, plants may have been used during funerary rituals as well.

Our comparative analysis noted seven times greater density of identified floral remains and five times greater density of total floral remains at Körösladány-Bikeri than at Vésztő-Bikeri. When only identified domestic taxa are considered, the density at Körösladány-Bikeri is still four times higher than at Vésztő-Bikeri. Bell-shaped pits account for the most significant difference regarding the abundance of domesticates, with 15 times higher values at Körösladány-Bikeri than at Vésztő-Bikeri. In addition, a much higher density (two to five times higher) of domestic specimens was recorded in other feature types (enclosures, other pits, and burials) in each context at Körösladány-Bikeri. Differential taphonomic processes cannot, alone, account for the marked differences in the frequency of macrobotanical remains at these sites. The same recovery and identification methods were applied by the same analyst for both assemblages.

The different frequencies of domesticates at the Bikeri sites may be related to shifts in agricultural practices over time. In this scenario, after their movement from Vésztő-Bikeri to Körösladány-Bikeri, the Early Copper Age community may have intensified crop production. Cereals, in particular, were produced in a larger quantity than at the Vésztő-Bikeri settlement. The composition of cereal species also changed. The proportion of unidentifiable cereal remains is fairly high at both sites—40 percent at Vésztő-Bikeri and 77 percent at Körösladány-Bikeri—but barley seems to have replaced wheat as the most important staple crop at Körösladány-Bikeri (Figure 15.7). Millet was grown less frequently, but the significance of legumes and gathered plants also appears to have increased at Körösladány-Bikeri.

A trend toward an increasing reliance on the more resistant and adaptive barley in subsistence economies has been proposed for the Carpathian Basin by the Early Copper Age (Gyulai 2010:82). Although some associated this shift with changes in the climate (e.g., Bognár-Kutzián 1972:170; Gyulai 2001:85–86), any evidence of a rapid deterioration in climatic conditions during the Tiszapolgár period is lacking from the Great Hungarian Plain and neighboring regions (see Chapters 2 and 3, this volume). Instead, our data from the Bikeri villages indicate that the modifications in agricultural practices at Körösladány-Bikeri were driven primarily by decisions made to increase the scale of cereal production. As suggested by the abundance of cereals, the emphasis on barley production, and the presence of a large quantity of arable weed specimens in the floral assemblage from that site, the intensification of agricultural production might have been accomplished through a shift to different farming practices at Körösladány-Bikeri.

The movement of the Vésztő-Bikeri community across the Dió Creek paleomeander may have been triggered by more available, possibly drier, arable lands. In fact, the Dió Creek paleomeander may have been inactive during

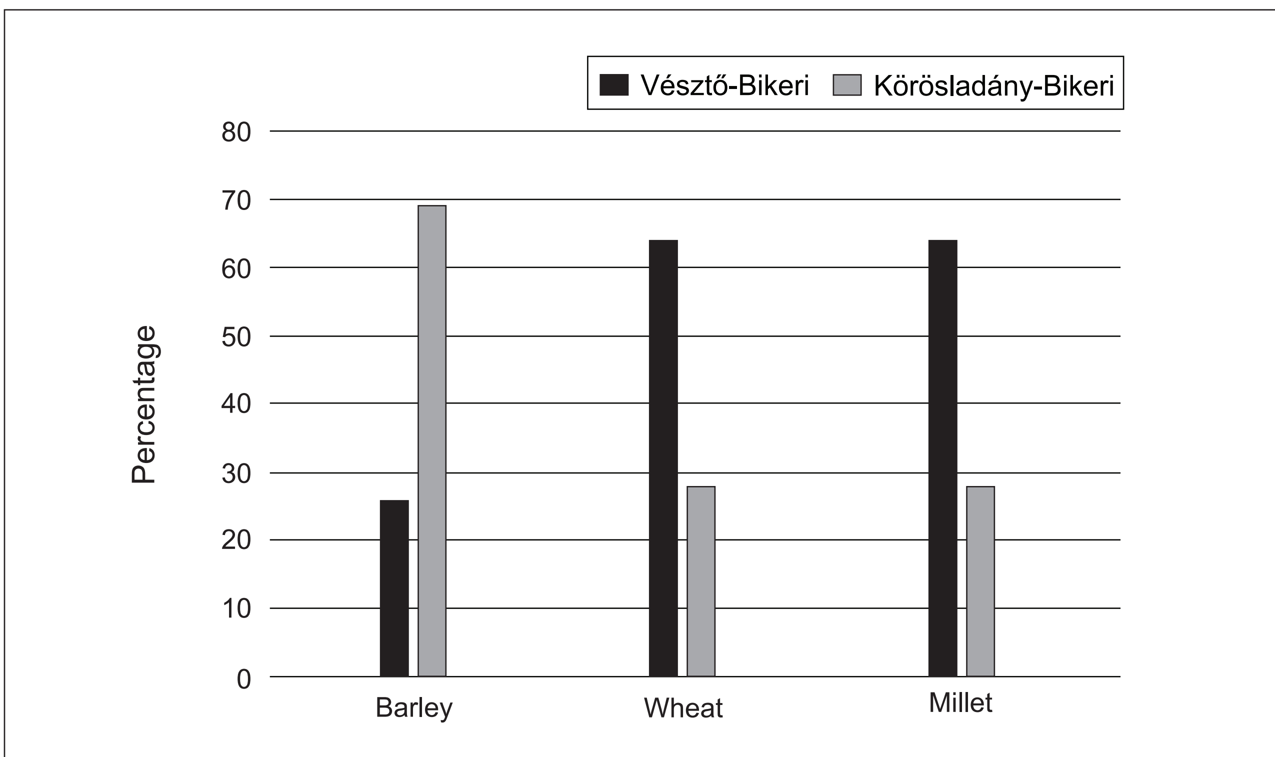


Figure 15.7. Percentage of identified cereals recovered in flotation samples from Vésztő-Bikeri and Körösladány-Bikeri. Sources: Tables 15.1 and 15.2. *Figure by Kimberly Kasper and Richard W. Yerkes.*

the Holocene (see Chapter 2, this volume) and may have drained floodwaters from the Sebes-Körös River, making the area west of the paleomeander less prone to the impact of recurrent flood events. The increase of cereal cultivation at Körösladány-Bikeri may have been fostered by changes in farming technology as well. The introduction of ox-drawn ard plowing likely occurred sometime around the Late Neolithic or the Copper Age throughout southeastern Europe (Chapman 1981; Sherratt 1981). Animal-drawn ard cultivation would have allowed the clayey soil of the Bikeri micro-region to be prepared more efficiently for sowing and thus allowed much larger fields to be cultivated.

Taken together, different farming practices may have been adopted by the same community of the two Early Copper Age villages. At Vésztő-Bikeri, a smaller-scale, more labor-intensive horticultural system—similar to the one described by Harris (2007:23–25)—or the intensive garden cultivation of both domesticates and useful wild plants outlined by Bogaard (2004:159), Halstead (1989), and Isaakidou (2011:100–1) may have prevailed. Floodplain horticulture exploiting low-lying alluvial lands by utilizing the refertilization effect of annual flood events to cultivate crops—proposed by Kosse (1979) for the Körös region during the Neolithic—also may have been applied. However, to avoid the devastating impacts of spring floods on the plants, only spring-sown domesticates could have been grown in the alluvial areas. Although the legume remains suggest that intensive practices persisted at Körösladány-Bikeri, the residents of that settlement may have moved toward a system of larger-scale crop husbandry. This shift to more extensive cultivation, possibly with the use of the ard, would have resulted in lower yields per area but higher yields overall without regular external labor input beyond the village community (Halstead 1995). This strategy previously was assumed to have been adopted in the Bronze Age in the Carpathian Basin and the Balkans (Bailey 2006:522–23; Reed 2012; Willis 1994).

The causal factors of these modifications in crop production practices at Körösladány-Bikeri remain ambiguous. The size of the Bikeri sites is very similar, but we have no information about the density and numbers of Early Copper Age domestic structures from Körösladány-Bikeri, making it difficult to estimate population size for that site. However, it is unlikely that the population was significantly larger at Körösladány-Bikeri than at Vésztő-Bikeri, requiring intensification in agricultural production.

A potential explanation could be that the diet of the Körösladány-Bikeri residents was more cereal-based than that of those at Vésztő-Bikeri. The faunal analyses, however, indicate a high degree of similarity in the scale and composition of livestock; animal protein was important in the diet at both sites (see Chapter 14, this volume). The change in cultivation strategies may have sought to achieve a different goal: the production of surplus grain. The frequent occurrence of bell-shaped pits, commonly associated with crop storage, at Körösladány-Bikeri appears to support this argument. Although a risk-management strategy to counteract environmental hazards in the micro-region may explain surplus production as a buffering mechanism, an increase in the scale of crop husbandry also would have generated surplus that could be used to participate in regional interactions. However, the question of what economic or social benefits were gained in return remains unclear. The potential economic benefits may have included access to labor and imported goods, such as animals, hides, textile, salt, stones, and metals. The potential social benefits may have included opportunities for intercommunity alliance-building and maintenance through the organization of feasts and other communal events.

Conclusions

The analysis of the floral remains from Vésztő-Bikeri and Körösladány-Bikeri indicates that the residents of these Early Copper Age villages developed resource management practices that relied on, as well as increased, the environmental diversity of the micro-region. These practices may have been part of a risk-buffering strategy that aimed to ensure food security for the community in case of poor harvests. Such a strategy would have been remarkably important in a social context characterized by dispersed, autonomous communities with a low degree of external trade and exchange relations, at least compared to the preceding Late Neolithic period (Gyucha 2015; Gyucha and Parkinson 2013; Parkinson 2006a; see also Chapters 10 and 12, this volume).

Given the small size of the macrobotanical assemblages from the Bikeri sites, the scale of farming and the importance of cultivated and gathered plants in the diet may appear somewhat ambiguous. However, when the density of macrobotanical finds from the Bikeri sites is compared to the scant density data available from Neolithic sites on the Great Hungarian Plain and adjacent regions (Bogaard et al. 2007; Reed 2012:48–49), the value from Körösladány-Bikeri is comparable to, and in many cases higher than, most Neolithic settlements. In addition, the diverse composition of domesticates in the assemblages—representing the vast majority of cultivated crops recovered from Neolithic and Copper Age sites in the

Carpathian Basin (Gyulai 2010; Reed 2012)—also indicates the importance of farming in the subsistence economies of the Bikeri settlements.

Some have proposed a profound change in agricultural practices, including a radical decline in crop husbandry and an overwhelming reliance on a specialized pastoral economy, after the Neolithic on the Great Hungarian Plain (Bánffy 1994; Bognár-Kutzián 1972; Bökönyi 1974; Gyulai 2010:82; Horváth 2005). Although the contributions of animal and plant sources to the caloric intake of the Bikeri villagers cannot be estimated accurately, the macrobotanical finds from the sites provide clear evidence that the smaller-scale communities that established their own settlements after the abandonment of large, nucleated, Late Neolithic sites continued several Neolithic crop production practices (see also Reed 2012:178). In fact, the increased abundance of cereals and arable weeds at the later Körösladány-Bikeri site indicates the growing significance of farming over the course of the Early Copper Age in the Körös region. As at Vésztő-Bikeri, a diversified strategy to reduce the risk of crop failure continued to be practiced at Körösladány-Bikeri, but a marked shift toward increased crop production, especially barley, also might have occurred, possibly to facilitate participation in regional social networks.

Chapter 16

Burials and Mortuary Practices

Julia Giblin and Michelle Hughes Markovics

Neolithic populations on the Great Hungarian Plain typically buried their dead within their settlements (Lichter 2001; Whittle 1996), but the Early Copper Age saw the emergence of formal cemeteries located away from residential sites throughout the Carpathian Basin (Bognár-Kutzián 1963; Chapman 1997). Although intramural burials in Tiszapolgár settlements had been noted in the past (Bognár-Kutzián 1972; Lichter 2003), the lack of large-scale, systematic investigations at Early Copper Age settlement sites precluded further research into these interments. Through the analysis of the burials found within the villages at Vésztő-Bikeri and Körösladány-Bikeri, this chapter contributes to studies of variation in Early Copper Age mortuary customs and to models of continuity and change during the Late Neolithic–Early Copper Age transition on the Great Hungarian Plain. We also provide basic descriptions of the two Hungarian Conquest period graves recovered from Vésztő-Bikeri, but they are not discussed here in detail.

Field and Lab Procedures

During fieldwork, human remains and associated grave goods at Vésztő-Bikeri and Körösladány-Bikeri were exposed and pedestalled. All features were mapped and photographed in the field. Flotation samples were taken from the deposit around burials to recover very small bones and macrobotanical materials (see Chapters 7 and 15, this volume). The flotation samples were processed using a modified SMAP flotation system (Watson 1976). The portion of the deposit that was not included in the flotation samples was dry-screened through 0.5 cm mesh sieves. Samples also were selected for radiocarbon dating.

The skeletal remains were brought back to the field lab in Vésztő for cleaning, identification, and analysis. The bones were cleaned using wooden tools, brushes, and diluted alcohol. All identifiable elements were labeled and recorded on inventory forms from the *Standards for Data Collection from Human Skeletal Remains* (SOD) manual (Buikstra and Ubelaker 1994). Determinations of sex, age, and pathology were made using the protocols in the SOD manual. Mortuary analysis for 2001 through 2003 was conducted by Michelle Markovics and Julia Giblin, and it was performed by Julia Giblin and Molly Lane in 2005 and 2006.

Burials and Human Remains from Vésztő-Bikeri

The skeletal remains of four complete individuals were recovered from Vésztő-Bikeri (Table 16.1; see also Chapter 7, this volume). The first burial, Feature 11, was found during the 2001 field season and dates to the Hungarian Conquest period (ninth to tenth century AD). In 2003,

Table 16.1. Inventory of burials from Vésztő-Bikeri and Körösladány-Bikeri

Site	Season	Block	Excavation Unit	Feature Number	Chronology	Age at Death
Vésztő-Bikeri	2001	2	2-168	11	Hungarian Conquest period	40–45 years
Vésztő-Bikeri	2003	7	7-058	71	Early Copper Age	30–39 years
Vésztő-Bikeri	2003	3	3-246	85	Early Copper Age	3–9 months
Vésztő-Bikeri	2003	2	2-463	108	Hungarian Conquest period	40–45 years
Körösladány-Bikeri	2005	3	3-018	1	Unknown, possibly Early Copper Age	3–9 months
Körösladány-Bikeri	2005	4	4-060	11	Early Copper Age	0–2 months
Körösladány-Bikeri	2005	4	4-061	12	Early Copper Age	0–2 months
Körösladány-Bikeri	2006	5	5-047	47	Early Copper Age	2–4 years

Table by Julia Giblin.

the skeletal remains of three additional individuals were excavated. Features 71 and 85 are assigned to the Early Copper Age based on the associated grave goods and a calibrated radiocarbon date from Feature 71 (see Chapter 8 and Appendixes IV and V, this volume). Another intrusive equestrian burial, Feature 108, with grave goods dating to the Hungarian Conquest period, also was recovered during that field season. Over the course of the excavations at Vésztő-Bikeri, additional scattered human remains were also found in various contexts.

Feature 71—Early Copper Age Adult Male Burial

Feature 71 was discovered in Block 7 below the plowzone (Figure 16.1). The burial was an adult male interred in an oval-shaped pit (about 1.3 x 1 m) west of the inner palisade trench (Feature 88) surrounding the village (see Chapters 7 and 8, this volume). The burial was placed on top of a posthole (Feature 74) after the post had been removed and the posthole had been filled in. Feature 74 is part of an arc of five large postholes that were exposed about 0.7 m inside of the palisade in Block 7 at Vésztő-Bikeri. The posts may have been supports for a platform along the interior of the palisade. The platform, and presumably the palisade, had been dismantled before the burial was placed over the posthole.

The individual in Feature 71 was interred in a tightly flexed position, possibly bundled, and lying on the right side (Figure 16.1). The body was oriented east–west, with the head aligned toward the east and the extremities oriented west. The head was placed facedown and the top of the skull was to the north. The back of the skull was damaged during removal of the plowzone. Two Tiszapolgár ceramic vessels were included in the burial. The larger is a closed pot decorated with two pierced lugs below the rim (Figure 16.1A). It was placed in the deceased's hands, as if he were holding it. The other ceramic is a small open cup with four pierced lugs (Figure 16.1B). A freshwater clamshell was found near the front of this vessel, as if it had tumbled out of the cup after deposition. Red ocher stains were encountered under the tibiae. Seven cereal seeds found in the fill might have been thrown intentionally into the burial pit as part of the ritual (see Chapter 15, this volume). A portion of a pig (*Sus domesticus*) mandible with two intact molars was recovered 4 cm directly above the larger vessel; it is ambiguous whether it was intentionally placed in the burial. The fill contained Tiszapolgár sherds, faunal remains, and shell fragments in secondary contexts. During lab analysis, it was discovered that an isolated subadult humerus from another individual was present in the burial fill as well. While charcoal flecking was observed throughout the fill, the largest fragments were directly beneath the skeletal elements. A radiocarbon date on a sample of these larger charcoal pieces shows a one-sigma range of 4487–4369 cal BC (Yerkes et al. 2009; see also Chapter 8 and Appendix V, this volume).

The Feature 71 burial contained at least 17 freshwater clamshells (*Unionidae* family). These shells were placed throughout the burial, both above the body and below it; several were found in direct contact with skeletal elements. There was what appeared to be an intentional grouping near the legs (Figure 16.1). Some shells were in close association with, or covering, charcoal pieces. Interestingly, the majority of the shells unearthed from above the body had the concave side (inside) facing down, while many of the intact shells from under the body had the concave side facing up. Some, however, were found with both valves of the shell still together.

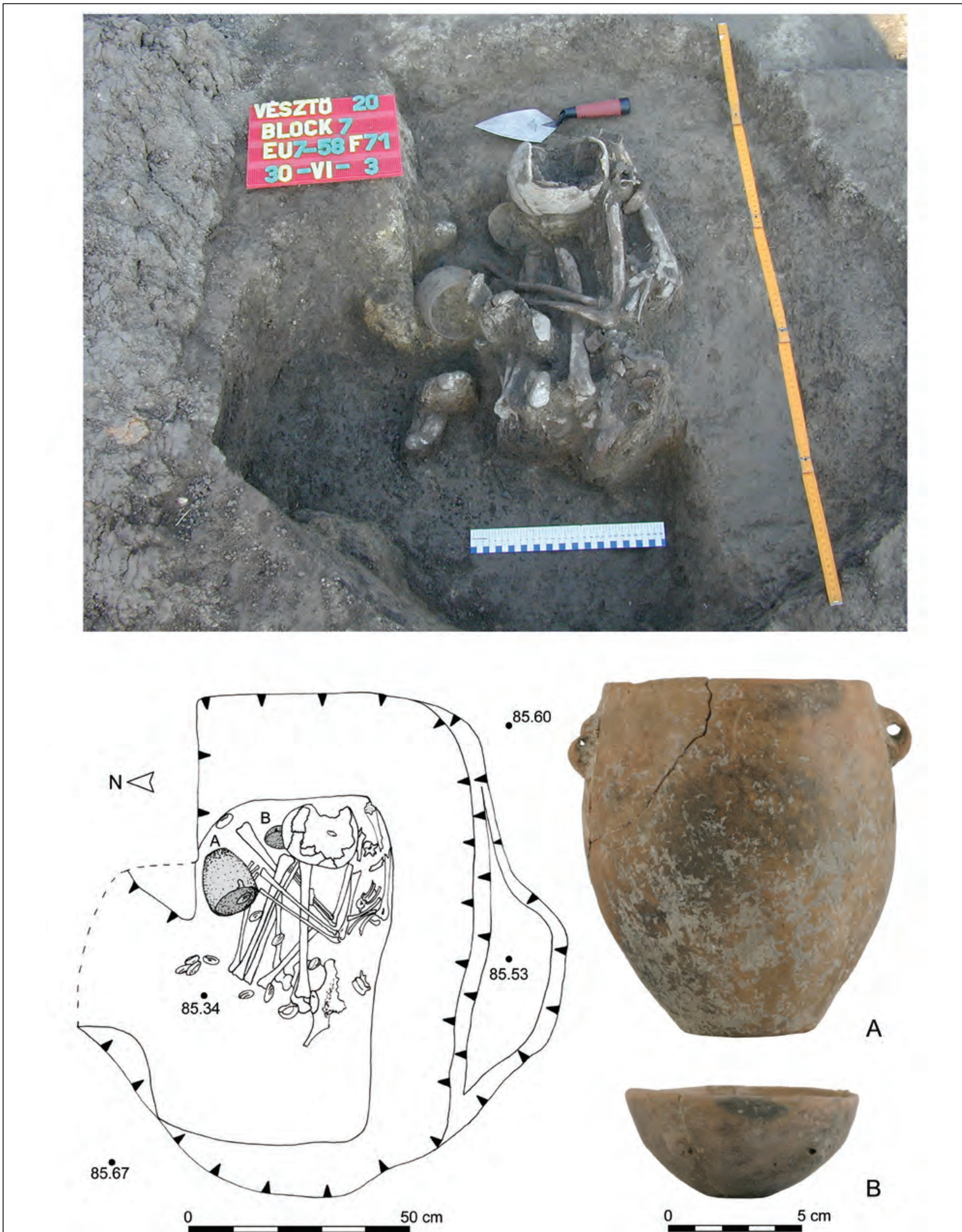


Figure 16.1. Early Copper Age adult burial (Feature 71) lying over the filled-in posthole (Feature 74) in Block 7 at Vésztő-Bikeri. A: Pot (V20-7-058-20); B: Bowl (V20-7-058-21). Scale in photo is 30 cm long, trowel points north. *Figure by Julia Giblin, Dorottya Kékegyi, and Attila Nyári.*

In addition to the placement of the body on the right side, a characteristic regularly associated with males in Tiszapolgár cemeteries (see Bognár-Kutzián 1972), the morphology of the skeletal remains indicates that the individual in Feature 71 was a male. Many of the sexually dimorphic traits used to distinguish between males and females could not be employed, but skull traits (mastoid process, supraorbital margin, and mental eminence) and pelvic traits (greater sciatic notch and preauricular sulcus) support this sex identification. Lacking an observable pubic symphysis or sutures, the age of the individual was difficult to assess, but age-related changes on the auricular surface of the pelvis (right side only) suggest that he was a middle-aged adult, approximately 30 to 39 years old.

Observable dental pathologies include three caries (located on the left maxillary second incisor, canine, and third premolar) and heavy calculus and wear throughout the mouth. Several teeth in the mandible and maxilla were lost pre-mortem based on evidence for healing of the alveolar bone, and there is evidence of mild periodontal disease. Other notable skeletal pathologies include the condition of the spine; the individual's vertebrae exhibit mild lipping on the vertebral body and all the vertebrae are compacted or compressed and slightly asymmetrical (lean anterior-laterally).

Feature 85—Early Copper Age Subadult Burial

The remains of a subadult were found just north of the northern wall trench (Feature 78) associated with the Feature 5 house structure in Block 3 at Vésztő-Bikeri (see Chapters 7 and 8, this volume). The body appears to have been buried in a shallow pit, but the exact contours of this pit could not be defined (Figure 16.2). The skeleton was in very poor condition and many of the bones were unidentifiable. The body was loosely flexed and oriented with the skull east and the lower extremities west. The location of certain skeletal fragments suggests that it may have been placed on the left side. One nearly intact Tiszapolgár tumbler, decorated with four lugs near the base and two lugs below the rim (Figure 16.2A), and a small cup with four lugs (Figure 16.2B) were found directly south of the skull. Ceramic sherds, animal bones, and daub were scattered throughout the fill of the burial. There was no evidence for charcoal or freshwater clamshells found in the Feature 71 burial.

Due to the poor condition of the skeletal material from Feature 85, only limited lab analysis was possible. The deciduous dentition was used to approximate the age of the individual. All the teeth recovered are loose and lack root formation except for the left second incisor, which was found unerupted in the maxilla. This indicates an age of six months plus or minus three months. None of the vertebral elements recovered show signs of fusion, which also supports an age of younger than four years at time of death.

Other Prehistoric Human Remains from Vésztő-Bikeri

Isolated remains of at least three other subadults were recovered from Blocks 7 and 8 at Vésztő-Bikeri. Long bones were found in the fill of the Feature 88 inner ditch in Block 7 (Feature 87), and the cultural layer in Block 8. The isolated humerus exposed in the fill of the Feature 71 burial, discussed above, also is from a child. Four other human bone fragments were unearthed in the central section of the settlement in longhouse-related features and in the cultural layer. None of these bones seem to be associated with any recovered burials at the site, and they date either to the Early Copper Age or a preceding period. An additional, redeposited, subadult femur was recovered from the Feature 108 Hungarian Conquest period burial in Block 2 (see below), which also might be prehistoric. During surface collection in 1998, Parkinson (2006a:118) observed the lower leg bones of a partially plowed out, possibly prehistoric human burial (Surface Feature 2) at the southern edge of Vésztő-Bikeri.

Feature 11—Hungarian Conquest Period Burial

In Block 2, a Hungarian Conquest period burial intrusive into the Early Copper Age Feature 4/14 longhouse was excavated (Figure 16.3A). The feature contained an adult male buried with the head and hooves of a horse. The extended skeleton was found in an oval, hardly observable pit oriented southwest–northeast, with the head facing slightly northwest. The right hand was placed on the pelvis and the left hand was found on the spine. The horse skull was removed prior to the excavation of the rest of the grave, and its exact position in the pit is unclear. The horse hooves were lying on and along the left leg. A pair of iron stirrups and an iron bit were located below and above the horse bones. Additional grave goods include an iron buckle, a lockring, two small sheets of silver, and a bronze bracelet. The burial fill contained Tiszapolgár ceramics, daub, and faunal remains in secondary position. The male individual was 40 to 45 years old at time of death. The left lower arm exhibits a healed fracture. This burial is discussed in more detail in Lichtenstein (2004).

Figure 16.2. Early Copper Age infant burial (Feature 85) in Block 3 at Vésztő-Bikeri. Scale in photo is 30 cm long, trowel points north. A: Tumbler (V20-3-246-6); B: Mug (V20-3-246-5). *Figure by Julia Giblin, Dorottya Kékegyi, and Attila Nyári.*

Figure 16.3. Hungarian Conquest period equestrian burials in Block 2 at Vésztő-Bikeri. A: Feature 11; B: Feature 108. Scale bars indicate 20 cm units, trowels point north. *Figure by Attila Gyucha and William A. Parkinson.*

Feature 108—Hungarian Conquest Period Burial

A second intrusive Hungarian Conquest period burial was found in Block 2 (Figure 16.3B). The individual was an adult male interred in an oval pit with the skull and legs of a horse. The body was in a supine position, with the head oriented southwest and the lower extremities northeast. The hands were clenched and resting in the lap. A right subadult femur was found on the individual's right humerus. The horse skull was resting against the left tibia, facing southwest. Four horse legs (astragalus down to hooves) were located around the feet. Grave goods included a horse bit, a belt buckle, and four arrowheads, all made of iron. The fill around the burial contained Tiszapolgár cultural material.

Lab analysis indicates that the individual was a male (estimate based mostly on skull traits due to the friable nature of the pelvis) of 40 to 45 years of age (based on age-related changes to the auricular surface of the pelvis). Several skeletal pathologies were identified. These include fused lumbar vertebrae, calcaneal and vertebral entheseopathies, and frequent osteophytic activity on a number of bones. All dentition exhibited unusual wear and calculus. Caries were identified in several teeth and periodontal disease was identified throughout the mouth.

Burials and Human Remains from Körösladány-Bikeri

The remains of four subadult skeletons were excavated from Körösladány-Bikeri (Table 16.1). Three burials (Features 1, 11, and 12) were recovered in 2005 and one (Feature 47) in 2006. Based on the associated Tiszapolgár artifacts, Features 11, 12, and 47 date to the Early Copper Age. Feature 1 was identified in the plowzone and its chronological affiliation remains ambiguous.

Feature 1—Infant Burial

The burial was identified as a cluster of human bones, faunal remains, and several ceramic sherds during the removal of the plowzone in Block 3 (see Chapters 7 and 8, this volume). The skeletal remains recovered from Feature 1 include most of the deciduous teeth and fragments of the skull, vertebrae, ribs, and long bones. Based on deciduous tooth development, the individual was six months old (plus or minus three months) at time of death. No pathologies were found during lab analysis. Because the human remains appeared to be mixed with midden fill in the plowzone, and grave goods were not recovered, the burial may date either to the Early Copper Age or a later time period.

Features 11 and 12—Early Copper Age Infant Burials

Two infant skeletons located about 30 cm from one another were found in Block 4 (Figure 16.4; see Chapters 7 and 8, this volume). Both burials were laid on top of the lower cultural layer and both were covered with Tiszapolgár vessels and then mounded over with the upper mantle of cultural material. No burial pits were identified, and the burials were not associated directly with any other identified features.

Feature 11 was found underneath two large, superimposed pieces of a pot decorated with multiple lugs in the shoulder and the body (Figure 16.5). The vessel was nearly complete when reconstructed; it appears that the intentionally broken vessel was placed over the body. The body was flexed and positioned on the right side. It was lying east–west, with the head pointing east. A lid fragment, an intact Tiszapolgár cup, a grinding stone, animal bones, and multiple Early Copper Age ceramic sherds were found near the burial, slightly above the skeleton, but these finds cannot be related securely to the burial.

According to the sequence of deciduous dental development, the age of the subadult was birth plus or minus two months. The enamel on the maxillary incisors exhibited a dark reddish-brown color. The discoloration probably was caused by taphonomic processes in the burial environment, such as contamination from groundwater, rather than pathology. All the vertebrae, scapula, long bones, pelvis, and skull elements were unfused, supporting the young age of the individual. No pathologies were identified.

Feature 12 was found southeast of Feature 11 (Figure 16.4). Like Feature 11, the body was covered with a ceramic vessel broken into two pieces that were placed on top of one another over the individual (Figure 16.6). The vessel is a large bowl with a flaring profile decorated with four large lugs. The poorly preserved skeleton was flexed and lying on the right side, with the head to the northeast and the lower extremities to southwest. The skull was extremely fragmented and could have been placed facing downward or on the right side. Grave goods were not found.

Based on the deciduous teeth, the age of the Feature 12 infant was birth plus or minus two months at time of death. The enamel on the maxillary incisors has a brownish tint. All the vertebral pieces, scapula, and long bones were unfused, supporting the young age of the individual. No pathologies were identified.

Figure 16.4. Early Copper Age neonate burials (Features 11 and 12) before and after the removal of the broken Tiszapolgár vessels in Block 4 at Körösladány-Bikeri. A: View from above before removal of vessels (K14-4-037-5, K14-4-060-1, and K14-4-061-1); B: View from above after removal of vessels. Feature 12 is in the southeast corner of the unit. Feature 11 is in the northwest corner. Scale bars indicate 20 cm units, trowels point north. *Figure by Attila Gyucha.*

Figure 16.5. Early Copper Age burial (Feature 11) covered by a ceramic pot (K14-4-060-1) in Block 4 at Körösladány-Bikeri. Trowel in photo points north. *Figure by Dorottya Kékegyi and Attila Nyári.*

Figure 16.6. Early Copper Age burial (Feature 12) covered by a ceramic bowl (K14-4-061-1) in Block 4 at Körösladány-Bikeri. Trowel in photo points north. *Figure by Dorottya Kékegyi and Attila Nyári.*

Figure 16.7. Early Copper Age infant burial (Feature 47) in the Block 5 extension at Körösladány-Bikeri. A: Tumbler (K14-5-127-3); B: Tumbler (K14-5-127-2); C: Tumbler (K14-5-127-1). Scale bars in photo indicate 20 cm units, trowel points north. *Figure by Julia Giblin, Dorottya Kékegyi, and Attila Nyári.*

Feature 47—Early Copper Age Subadult Burial

The skeleton of a subadult was recovered in the Block 5 extension (Figure 16.7), between the palisade (Feature 8) and the middle ditch (Feature 30) of the enclosure surrounding the Körösladány-Bikeri village (see Chapters 7 and 8, this volume). The grave was found within the upper cultural layer, but it was not lying on the top of the lower cultural layer like Features 11 and 12. The burial pit was not identified, and the feature is not directly associated with any of the surrounding features in Block 5.

The body was flexed and lying on its left side, with the head pointed east and the lower extremities to the west. The left arm of the poorly preserved skeleton was missing and the skull was cracked. Three tumblers decorated with multiple lugs were recovered above the extremities. Fragments of a Tiszapolgár cup were found alongside the skull, but it may not be associated with the burial. Scattered, small pieces of ocher also were noted near the body.

Based on dental development, the child's age at death was three years plus or minus 12 months. Portions of the vertebrae, pelvis, and long bones that were observable were all unfused except for the neural arches of the axis. The teeth present have a brownish staining similar to Features 11 and 12. No pathologies were observed.

Burial Practices at the Bikeri Sites in Context

The Early Copper Age burials found during excavations at Vésztő-Bikeri and Körösladány-Bikeri included one adult and at least four subadult individuals. Scattered human bones recovered from secondary contexts came from an additional minimum of three prehistoric subadults. The chronological positions of the cluster of human bones documented on the surface at Vésztő-Bikeri and one of the excavated infant burials at Körösladány-Bikeri (Feature 1) are uncertain. Two intrusive Hungarian Conquest period burials also were encountered at Vésztő-Bikeri (for further discussion, see Lichtenstein 2004).

The Tiszapolgár burials at the Bikeri sites were interred within the settlement boundaries. Two of the graves at Vésztő-Bikeri (Features 71 and 85) were located above or near abandoned structures. They either were interred in unused areas of the settlement or were buried at the site after the settlement had been abandoned (see Chapter 8, this volume). The former would be consistent with Late Neolithic mortuary practices on the Great Hungarian Plain (Kalicz and Raczky 1987a; Lichter 2003), whereas the latter would suggest the secondary use of the abandoned settlement for burying at least some of the dead (Gyucha 2015). At Körösladány-Bikeri, several Early Copper Age burials (Features 11, 12, and 47) were not directly associated with any other features. They were laid on the top of the lower cultural layer or were incorporated into the upper cultural layer (see Chapters 7 and 8, this volume). These interments could have occurred both during and shortly after the habitation of the settlement.

In addition to formal cemeteries separated from residential sites, burials occasionally have been found within settlements on the Early Copper Age Great Hungarian Plain and the surrounding areas (Bognár-Kutzián 1972; Iercoşan 2002). In the Körös region, previous excavations at Tiszapolgár settlements regularly revealed contemporaneous burials. In fact, only two sites in the region may be regarded as formal cemeteries (Okány-Futás and Vésztő-Mágor), and 40 percent of the 46 currently known, securely dated Early Copper Age burials in the region are from settlements (Gyucha 2015). These include both subadults and adults buried with similar mortuary practices as those interred in Tiszapolgár cemeteries. This suggests that intramural burials persisted throughout the Early Copper Age in the Körös region.

All the Early Copper Age burials from the Bikeri sites appeared to be flexed, and most were oriented with the heads to the east. This placement is typical across the Great Hungarian Plain (Bognár-Kutzián 1972), although variations exist (e.g., Bognár-Kutzián 1963; Foltiny 1941). While burial in a contracted position was more typical throughout the Neolithic, body side placement according to biological sex began in the Late Neolithic, with the placement of males on their right side and females on their left (Lichter 2003).

The grave goods in the Bikeri burials included only two to three ceramic vessels placed near the skulls and extremities, but goods other than pots also were deposited in Tiszapolgár burials in the Körös region (Gyucha 2015). Red ocher in burial contexts, which was documented in graves at both Vésztő-Bikeri (Feature 71) and Körösladány-Bikeri (Feature 47), occurred from the Early Neolithic onward on the Great Hungarian Plain (Paluch 2012). Its use was especially common in Late Neolithic burials across the Körös region (Hegedűs 1977; Hegedűs and Makkay 1987; Szeghalmi 1913). As with Feature 71 at Vésztő-Bikeri, the deposition of freshwater clamshells has been noted in southeastern European Neolithic mortuary contexts (Bacvarov 2013), and they have been recovered from numerous Early Copper Age graves in the Körös region (Gyucha 2015). Examples include the nearby sites of Bélmegyer-Mondoki-domb (Goldman 1977), as well as the Vésztő-Mágor tell, where thick layers of clamshells were revealed in association with burials (Hegedűs 1977). The lack of similar observations from Tiszapolgár sites in other parts of the Great Hungarian Plain suggests that this practice was specific to the Körös region.

No known Early Copper Age cemetery is linked to the Vésztő-Bikeri and Körösladány-Bikeri villages. However, relatively large numbers of Tiszapolgár burials were recovered at the Vésztő-Mágor tell, located only 2 km north of the Bikeri villages (Hegedűs and Makkay 1987). A total of 20 Early Copper Age burials were identified at that site (Hegedűs 1977; Makkay 2004). Most were interred oriented southeast–northwest or east–west in a contracted position. The number of grave goods usually was much higher than that of other Tiszapolgár burials in the Körös region and primarily included ceramics, up to 12 items, as well as beads, stone axes, antler tools, a wild boar tusk pendant, animal bones, and a small number of copper artifacts (see Gyucha 2015:Appendix). Seven child burials at Vésztő-Mágor were recovered from the area of the remains of a burned Tiszapolgár house, which may have served as a children's graveyard (Makkay 2004). Nearly equal proportions of subadults and adults occurred in other parts of the site. Based on the original field documentation, Gyucha (2015:206) argued that the Tiszapolgár burials at Vésztő-Mágor were parts of a cemetery that was established soon after the abandonment of the Early Copper Age settlement on the tell.

A great deal of continuity is evident in Late Neolithic and Early Copper Age mortuary practices (Chapman 1997; Gyucha 2015; Lichter 2003; Skomal 1980), yet there is a notable difference in burial rituals at Vésztő-Bikeri and Körösladány-Bikeri, especially regarding the treatment of subadults. Four subadult burials securely dated to the Tiszapolgár period were excavated at Vésztő-Bikeri and Körösladány-Bikeri. In addition, another grave at Körösladány-Bikeri (Feature 1) and the unarticulated remains of several subadults with ambiguous dating were recovered in Early Copper Age midden fills and cultural layers at Vésztő-Bikeri. There is significant variation in subadult burial treatment, and it is possible that some of the disarticulated infant remains without associated grave goods are intrusive.

One possible explanation for this variation is that age determined the type of burial treatment. For example, in many cultures infants are not recognized as members of the family or the larger community until they reach a certain age. This custom usually is associated with high infant mortality rates (McHugh 1999). The Early Copper Age subadults buried with grave goods at the Bikeri sites range in age from neonatal to three years old, suggesting that this age may have been recognized as important by the community.

Another possible explanation for the difference in subadult burial practices could be that they were secondary or delayed burial rituals. The isolated subadult skeletal remains at Vésztő-Bikeri could indicate that the Early Copper Age inhabitants deliberately redeposited all or specific parts of subadult skeletons. Alternatively, all or some of the remains may have been scattered across the site at a later time. The isolated subadult skeletal remains at Vésztő-Bikeri also may be associated with the accidental disturbance and disassembly of complete burials interred into the site during the initial phase of the Early Copper Age settlement, or even preceding the Tiszapolgár habitation.

Among the four subadult burials, one was buried in a pit with ceramic vessels and a possible association with an abandoned house structure (Feature 85 at Vésztő-Bikeri). One was buried with ceramic vessels but no association with a structure (Feature 47 at Körösladány-Bikeri). Two burials were covered with large, broken ceramic vessels and presumably no association with a structure (Features 11 and 12 at Körösladány-Bikeri). A possible distinction can be made between the burials with associated ceramic grave goods and those covered by ceramics. The subadults found covered by Tiszapolgár vessels (Features 11 and 12 at Körösladány-Bikeri) are both neonates. The subadults found with small Tiszapolgár vessels as grave goods (Feature 85 at Vésztő-Bikeri and Feature 47 at Körösladány-Bikeri) are older (six months to three years). This may indicate a differential treatment of subadults by age of death, at least at the Körösladány-Bikeri settlement.

Subadult burials covered with ceramic vessel fragments are found only at Körösladány-Bikeri, and the practice has not been documented at any other Tiszapolgár sites to date. There are several cases of cremations and child burials interred in pots and bowls at Neolithic and Chalcolithic sites in southeastern Europe and the Levant (Bacvarov 2006; Bader 1989; Caskey 1957; Fowler 2004; Georgiev 1972; Lichardus-Itten et al. 2002; Todorova 2002; Vasić 1932–1936; Wace and Thompson 1912; Yaker 1991). Bacvarov (2008) argued that the practice of burying infants in ceramic vessels is an element of social reproduction and cohesion that was transferred to southeastern and central Europe via neolithization routes from the Near East. On the Great Hungarian Plain, this mortuary custom occurred during the Early and Middle Neolithic (Gazdapusztai 1957; Sebők 2013), but similar data is lacking for the Late Neolithic period.

The closest analogies to the Körösladány-Bikeri burial rituals in both geographic and chronological terms are west of the Danube River, in southeastern Transdanubia, where neonate and infant burials inside ceramic vessels date to the Late Neolithic in the Lengyel culture. For example, in the Mórágy-Tűzkődomb cemetery, the skull of an infant was found inside a pedestalled vessel, and two infants were found in contracted positions inside vessels (Zalai-Gaál 2002:138, Figure 246, 141, Figure 116). Additional infant pot burials recently have been recovered during salvage excavations in contemporaneous Lengyel cemeteries at Alsónyék-Kanizsa-Flur (Zalai-Gaál 2010) and Alsónyék-Bátaszék (Osztás et al. 2016:185, Figure 3). Based on mortuary practices, architectural features, ceramic characteristics, and lithic assemblages, several researchers have proposed regular contacts between the Late Neolithic communities of the Great Hungarian Plain and Transdanubia (Bánffy 1994; Bognár-Kutzián 1963; Horváth 1986; Raczky et al. 2007; Starnini et al. 2007). Some have argued for migrations of Lengyel groups to the Great Hungarian Plain during the Late Neolithic (Horváth 1988, 2005; Sebők 2012). The burials of neonates in ceramic vessels at Körösladány-Bikeri may provide further evidence for these interregional connections. However, the degree of interaction between the Great Hungarian Plain and Transdanubia appears to have decreased significantly by the Early Copper Age (Gyucha 2015); it is also possible that the practice was a carryover from earlier Neolithic traditions on the Great Hungarian Plain.

Conclusions

Isolated cemeteries separated from settlements became common during the Early Copper Age on the Great Hungarian Plain, but Tiszapolgár communities also continued to bury their dead within the confines of villages and hamlets.

In addition to placing burials in settlements, several other mortuary customs at the Bikeri sites, such as body positioning according to biological sex and the use of red ocher, reflect continuity with Neolithic traditions in the Körös region. The position and orientation of the burials at Vésztő-Bikeri and Körösladány-Bikeri, as well as the types and quantity of associated grave goods, followed strict funerary rules and are similar to patterns observed in Early Copper Age burial contexts throughout the plain. However, some of the practices at these two villages, such as the placement of neonates underneath large ceramics and the use of freshwater clamshells, reflect regionally specific traditions.

The social and cultural norms that regulated which communities placed all or a certain faction of their dead in cemeteries or settlements during the Early Copper Age remain unclear. The complete burials and scattered human remains from the Bikeri sites suggest that the community regularly interred its subadults within the settlements, either during occupation or shortly after their abandonment. At the same time, the almost complete paucity of adult burials in the Bikeri archaeological record indicates that they were buried somewhere else.

Part V

Results and Conclusions

Chapter 17

The End of the Neolithic and the Dawn of the Copper Age

William A. Parkinson, Attila Gyucha, and Richard W. Yerkes

In this book, we have summarized the results of systematic archaeological investigations conducted by the Körös Regional Archaeological Project in the Vésztő micro-region centered around our intensive research at Vésztő-Bikeri and Körösladány-Bikeri. Prior to our work in the Körös region, the absence of systematically collected information from Early Copper Age settlement sites left a significant gap in our understanding of the transition from the Neolithic to the Copper Age on the Great Hungarian Plain.

We conducted multidisciplinary investigations, including gridded surface collection, geophysical prospection, soil chemistry, targeted excavation, and paleoenvironmental reconstruction, at two small, fortified villages: Vésztő-Bikeri and Körösladány-Bikeri. We also carried out complementary research at two other contemporaneous sites: Vésztő-Mágor and Okány-Futás. These local-scale investigations were complemented with regional-scale settlement studies in the Hungarian Körös region.

In this final chapter, we discuss the Late Neolithic–Early Copper Age transition on the Great Hungarian Plain and integrate the results of our multiscalar studies with other relevant research into the Neolithic and the Copper Age.

The Regional Scale: Early Copper Age Settlement Patterns in the Körös Region

The abandonment of tells and large horizontal settlements that had been occupied for hundreds of years during the Late Neolithic marked the beginning of the Copper Age on the Great Hungarian Plain. To gain a better understanding of the social and economic roots and importance of this process, we examined Late Neolithic and Early Copper Age settlement distributions in an area of 3,798 km² in northern Békés County that had been surveyed over the course of the Magyarország Régészeti Topográfiája (MRT) project. The MRT survey database provided the archaeological starting point and the landscape reconstruction was based on paleohydrological models and the pedological study of this area (Frolking 2004; Gyucha and Duffy 2008; Gyucha et al. 2011; see also Chapters 2 and 3, this volume).

Our research verified that the nucleated settlement pattern of the Late Neolithic, wherein smaller sites were tethered to tells and/or large horizontal sites, gave way to a highly dispersed pattern of more numerous, but significantly smaller, settlements in the Early Copper Age. The MRT survey data illustrate this trend: 62 Late Neolithic and 394 Early Copper Age settlement sites were recorded during the surface collection campaigns in the Körös region (Ecsedy et al. 1982; Jankovich et al. 1989, 1998). Systematic surveys at multiple sites indicate that, in stark contrast to the large Late Neolithic settlements, most Early Copper Age sites were 0.5 to 1 ha in size (Gyucha 2015; Parkinson 2006b). These values suggest that the extended corporate groups that occupied the household clusters identified at Late Neolithic tells and horizontal sites (Draşovean 1995; Kalicz and Raczky 1987a; Korek 1987, 1989; Raczky 2009; Raczky and Anders 2008) likely were the basic social units that abandoned the nucleated settlements and established their own autonomous hamlets and villages at the end of the Neolithic (Gyucha et al. 2014; Parkinson et al. 2010b).

Across the Körös region, Late Neolithic sites fall into discrete settlement clusters separated by 5 to 20 km of uninhabited buffer zones, but similar settlement clusters of Early Copper Age sites are more difficult to identify in many micro-regions. Additionally, where they can be discerned, Tiszapolgár site clusters are located in the areas of Late Neolithic clusters or were newly established in formerly uninhabited micro-regions (Gyucha 2015). These patterns suggest that the larger Neolithic communities that dispersed into smaller sites either maintained their previous territorial organization and group identity or formed new, larger-scale sociopolitical units. The overall increase in the number of sites in the Early Copper Age indicates that, regardless of these processes, Tiszapolgár villagers relocated their settlements more frequently. The two Bikeri sites demonstrate one example of site relocation on a micro-regional scale during the Copper Age.

In both the Late Neolithic and the Early Copper Age, sites in the study area were established in close proximity to watercourses, along the active waterways of the Körös River system and on the high ridges of Pleistocene oxbows. Many Tiszapolgár sites were located in areas that had been completely abandoned or only sparsely inhabited during the preceding period, filling in many of the unoccupied buffer zones that previously had separated Late Neolithic settlement clusters. This is especially true in the Körös–Berettyó Interfluve (Gyucha et al. 2011). Some of these areas are lower in elevation and likely were more exposed to floods and fluctuations in groundwater level, making them less favorable for agropastoral activities. Despite the tendency during the Early Copper Age to exploit more marginal areas of the region, there still is a nearly complete lack of Tiszapolgár sites in the northern part of the Maros Fan, which is characterized by chernozem soils favorable for farming and extensive grasslands ideal for grazing animals. However, there were no active watercourses in this landscape during the Holocene (Gyucha et al. 2009, 2011; see also Chapter 3, this volume).

Thus, during the Early Copper Age, the small, dispersed communities adapted to the highly heterogeneous, mosaic-like landscape of the Körös region. The Tiszapolgár agropastoralists were able to efficiently exploit local resources and remain close to the most important exchange and communication routes—the waterways. The location of the Bikeri sites on the Dió Creek near its confluence with the Sebes-Körös River is typical of other Early Copper Age sites in the Körös region.

Bayesian and contextual analyses of radiocarbon dates from several Late Neolithic and Proto-Tiszapolgár layers of tells on the Great Hungarian Plain overlap with the Tiszapolgár dates from the Early Copper Age Vésztő-Bikeri and Körösladány-Bikeri villages (Yerkes et al. 2009; see also Chapter 8, this volume). This suggests that the Copper Age way of life appeared earlier in our study area than in other parts of the Great Hungarian Plain and that several centuries passed before the social organization, practices, and material culture that would come to differentiate the Early Copper Age communities from their Late Neolithic predecessors became fully established throughout the Plain.

The Local Scale: Early Copper Age Settlement Organization

Our work identified a considerable amount of variation in Early Copper Age settlement organization in the Körös region (Parkinson et al. 2010b). At Bikeri, we excavated two small, fortified Early Copper Age agropastoral villages located only 70 m apart on both sides of the Dió Creek—Vésztő-Bikeri and Körösladány-Bikeri. By contrast, additional surface surveys and geophysical prospections at Okány-Futás revealed an unfortified hamlet at that location. Calibrated radiocarbon dates and detailed stylistic analyses of ceramics indicate that occupations at the Bikeri sites overlapped considerably in time during the Early Copper Age, between 4400 and 4200 cal BC, suggesting the movement of the same community from one locality (Vésztő-Bikeri) to the other (Körösladány-Bikeri; see Chapter 8, this volume). Both villages were inhabited for at least one generation, contradicting earlier assumptions that settlements were occupied only ephemerally during the Early Copper Age (Bognár-Kutzián 1972). The relatively thick stratigraphy and layout also imply that Vésztő-Bikeri and Körösladány-Bikeri were self-sufficient, year-round agropastoral villages, not seasonal pastoral camps.

Several features of the Early Copper Age occupations at the Bikeri villages exhibited strong cultural connections to Late Neolithic traditions. Enclosures composed of multiple ditches and palisades are common features at the Late Neolithic settlements of the Great Hungarian Plain and neighboring areas (Raczky and Anders 2012). Large longhouses with wall trenches were found at these

Late Neolithic sites, some of them built using the same construction techniques (*pisé de terre*, wattle-and-daub) employed at Vésztő-Bikeri (Gyucha et al. 2006; Hegedűs and Makkay 1987; Raczky 1987; Schier 2008). Based on geophysical prospection, surface collection, geochemical studies, excavations, and spatial analyses, we identified discrete activity zones within Vésztő-Bikeri: (1) a central residential area with multiple houses surrounded by; (2) an inner food-processing zone; (3) an outer zone along the inside of the palisade where livestock were kept; and (4) an extensive midden deposit that enclosed the settlement (see Chapters 4 to 8, this volume). A similar pattern of spatial organization has been reconstructed for Late Neolithic sites (Raczky 2009; Raczky and Anders 2008; Salisbury 2016).

Most large Late Neolithic settlements on the Great Hungarian Plain were subdivided into discrete household clusters (Gyucha et al. 2015; Raczky 1987; Raczky and Anders 2008). However, we were not able to identify individual household clusters within Early Copper Age settlements. The roughly 50 ha Tiszapolgár settlement at Geszt-Szalontai-zug, located on both sides of a tributary to the Sebes-Körös River at the eastern edge of the study area, is a possible exception. Its size and organization suggest that there may have been several household clusters at that site (Gyucha 2015; Gyucha et al. 2014), perhaps indicating more continuity with the Late Neolithic pattern of nucleation during the Early Copper Age in the easternmost portion of the Körös region.

Although the Early Copper Age is known for breaking away from the Neolithic tradition of burying the dead within settlements in favor of stand-alone cemeteries (for example, the type site of Tiszapolgár-Basatanya; see Bognár-Kutzián 1963, 1972), our research has demonstrated that the practice of intramural burial continued into the Copper Age. The graves at both the Bikeri sites as well as other Tiszapolgár sites on the Great Hungarian Plain (e.g., Gyucha 2015; Mészáros 2007; see also Chapter 16, this volume) indicate not only the continuation of this tradition but also micro-regional, if not site-specific, practices, such as the inclusion of shells as burial goods (Gyucha et al. 2014). The continued practice of intramural burial alongside the use of formal cemeteries raises the broader question of whether only some community members, perhaps those with certain achieved status, members of particular clans, or those with certain incipient forms of ascribed status (particularly at Vésztő-Mágor; see Gyucha 2015), were buried in Early Copper Age cemeteries.

Other characteristics suggest clear breaks with the ancestral Neolithic traditions. In addition to the adoption of cemeteries for some burials and the almost exclusive use of smaller, sometimes fortified, villages, there were significant changes in ceramic traditions and patterns of trade and exchange (see Chapters 9 and 12, this volume). Our work at the Bikeri sites indicates perhaps even more subtle shifts that occurred over the course of the Early Copper Age. For example, our inability to identify longhouses at the site of Körösladány-Bikeri suggests that house construction methods may have changed in the later phases of the Tiszapolgár period (circa 4300–4000 cal BC). This also could be related to the reorganization, and perhaps breakdown, of the larger households that were common throughout the Neolithic.

Making a Living: Early Copper Age Subsistence

The faunal assemblages from Vésztő-Bikeri and Körösladány-Bikeri—the first large, systematically collected and analyzed assemblages from Tiszapolgár settlement contexts (see Chapter 14, this volume)—permitted us to test previous assumptions about changes in subsistence strategies on the Great Hungarian Plain during the transition from the Neolithic to the Copper Age. The most common interpretation posited that subsistence shifted from a system based almost exclusive on sedentary farming to a more mobile system based heavily on pastoralism, with an increased reliance on specialized cattle husbandry (Bánffy 1994; Bognár-Kutzián 1972; Bökönyi 1974; Ecsedy 1981; Horváth 2005; Kalicz 1966; Siklódi 1982, 1983). However, our results from the Bikeri sites indicate a more complicated scenario, with continued reliance during the Copper Age on a mixed farming and herding economy, similar to that of the Late Neolithic, albeit with overall more reliance on domesticates.

In the Bikeri assemblages, domesticated species accounted for more than 90 percent of the NISP of mammals. Similarly, at the Early Copper Age settlement of Gyula-Remete-Iskola, located about 27 km away from the Bikeri sites in the southeastern part of the Körös region, 97 percent of identifiable fauna were from domesticated species (Gyucha 2015). Late Neolithic faunal data in the Körös region are available from Dévaványa-Sártó and the Szarvas-Kovácshalom tell (Bökönyi 1974, 1987), but sample sizes from those sites are very small and they derive from mixed Middle Neolithic Szakálhát and Late Neolithic Tisza contexts that render comparisons between Late Neolithic and Early Copper Age animal husbandry in the study area difficult. Across the Great Hungarian Plain, Late Neolithic sites display significant variability in the frequencies of domesticated animals in faunal assemblages—from 23 percent at Berettyószentmárton to 78 percent at Öcsöd-Kováshalom (Vörös 2005). In agreement with Bökönyi's (1974) interpretation based on Early Copper Age samples from mortuary contexts on the Plain, these results indicate that there was, indeed, an increased reliance upon domestic animals by the Tiszapolgár period.

While Bökönyi's argument for increased reliance on domesticates during the Early Copper Age holds up in light of the new information from the Bikeri settlements, his contention that there was an increased reliance on domestic cattle does not. The majority of domestic animal remains from Körösladány-Bikeri are from sheep and goats (41 percent of domesticates). At Vésztő-Bikeri, cattle dominate the domesticates (38 percent). At Körösladány-Bikeri, cattle are the second most frequent species, and at Vésztő-Bikeri sheep and goat are the second most abundant. Domestic pigs are well represented, albeit in lower frequencies, in both assemblages. These data do not suggest an intensive cattle-herding economy at the beginning of the Copper Age but rather are indicative of a balanced animal husbandry system.

Recent stable isotope studies and residue analyses also do not suggest an increased reliance upon animal husbandry, including intensification of cattle herding, in Early Copper Age subsistence strategies. Human remains from Late Neolithic and Copper Age sites throughout the Great Hungarian Plain exhibit no significant increase in $\delta^{15}N$ at the end of the Neolithic and the beginning of the Copper Age that would indicate increased consumption of meat from terrestrial animals (Giblin 2009, 2011; Giblin et al. 2013). In addition, although the consumption of dairy products is evident as early as the Early Neolithic in the region (Craig et al. 2005, 2007), lipid residue studies of pottery from the two Bikeri villages show no significant increase in the use of dairy products during the Copper Age (Hoekman-Sites and Giblin 2012; see also Chapter 10, this volume).

Instead of an overall reliance of a single species, there was a significant amount of variability in animal husbandry practices within the Körös region during the Early Copper Age. This variation in the composition of Tiszapolgár faunal assemblages may have been associated with differences in local environmental conditions, diet preferences, participation in various exchange networks, and small-scale diachronic variation. While at the Bikeri sites the results indicate no exclusive emphasis on any particular domestic species, at Gyula-Remete-Iskola, 83 percent of all domesticated animals were cattle. The high frequency of cattle at that site is likely due to its location in the boundary zone between the Körös region and the Maros Fan (Gyucha 2015). This was a steppe-like zone with extensive grasslands that, unlike the marshy areas in the interior of the Körös Basin where the Bikeri sites were located, would have been favorable for grazing large herds. In fact, slight differences in the compositions of the faunal assemblages from the sequential Vésztő-Bikeri and Körösladány-Bikeri sites may reflect gradual changes in animal husbandry practices at the local scale over the course of the Early Copper Age. If the context of the faunal remains is taken into account, there is no significant difference in the abundance of cattle, sheep or goat, and pigs at the two Bikeri sites (see Chapter 14, this volume).

The amount of macrobotanical remains recovered from flotation samples at Vésztő-Bikeri and Körösladány-Bikeri villages is small, most likely due to taphonomic processes (see Chapter 15, this volume). Despite the small amount, the variety of plant species represented is similar to those at Late Neolithic sites on the Great Hungarian Plain (Fischer and Rösch 2004; Füzes 1990; Gyulai 2005; Hartyányi 1988–1989; Hartyányi et al. 1968; Horváth 2005). The botanical remains include domesticated cereals such as einkorn and emmer wheat, common millet, legumes such as lentil and grass pea, and a variety of wild species. The composition of the floral assemblages reflects the mosaic-like surrounding landscape and indicates subtle farming and gathering strategies to prevent and counteract environmental risks.

Our studies of the Bikeri botanical assemblages verified fundamental changes in agricultural practices over time. Compared to the subsistence economy at Vésztő-Bikeri based on intensive horticulture, a significant increase in agricultural production might have occurred at Körösladány-Bikeri. This shift coincided with a sharp decrease in wheat production and an intensive reliance on barley as a staple crop that may have been triggered by advances in farming techniques. These developments might have allowed for the introduction of more extensive cultivation practices on the dense, clayey soils of the Körös region in the later phase of the Early Copper Age. The resultant agricultural surplus may have been exchanged for other materials and goods and/or could have been used to establish and maintain other forms of interaction in the region.

Overall, the Early Copper Age subsistence economy of the Körös region was a balanced system of field agriculture and animal husbandry, based on and rooted in local Neolithic practices. In this dynamic landscape composed of a mosaic of marshes, perennially inundated areas, river channels, and terraces, the prehistoric farmers appear to have sustained their agropastoral economy by creating new niches and tailoring their subsistence strategies primarily to fit local environmental conditions that changed over time. Thus, in each community, different species of livestock and different crops may have been favored.

Interaction Within and Between Regions: Early Copper Age Trade and Exchange

The Late Neolithic on the Great Hungarian Plain was characterized by complex networks of interregional trade and macro-scale interactions. Materials from remote areas, such as *Spondylus* shells from the Adriatic or Aegean and flint from what is today Poland, are found frequently in both graves and settlements. The tells and large horizontal sites served as nodes in the extensive trade networks of the Late Neolithic, coordinating long-distance contacts and the regional and micro-regional circulation of imported goods (Kalicz and Raczky 1987a; Makkay 1982; Szakmány et al. 2009).

Our excavations at the Bikeri sites indicate that the organization of trade networks changed profoundly after the Neolithic. The small amount of chipped stone tools, their extensive curation, and the limited amount of variation in raw materials suggest that access to raw material sources declined as the trade networks shifted and were reorganized at the beginning of the Copper Age (Gyucha and Parkinson 2013; Gyucha et al. 2004; Yerkes et al. 2007; see also Chapter 12, this volume). This conclusion contradicts previous models that posited that macro-regional and interregional interactions intensified during the Early Copper Age on the Great Hungarian Plain (Ecsedy 1981; Sherratt 1987).

Although they were not as robust as the trade networks of the Late Neolithic, Early Copper Age communities participated in multiple lithic trade networks that varied spatially throughout the Körös region. For example, Volhynian flint occurs in high frequencies in assemblages from Tiszapolgár settlements in the eastern Körös region and Carpathian obsidian occurs more frequently in the central part (Gyucha 2015; Gyucha and Parkinson 2013).

Unlike other parts of the Great Hungarian Plain (Kalicz and Raczky 1984; Raczky and Anders 2008), copper artifacts have not been found in significant quantities at Late Neolithic sites in the Körös region. At the beginning of the Early Copper Age, copper objects, including some larger tools, appeared in larger amounts in cemeteries, especially in the northern part of the Tiszapolgár area. By contrast, only a few copper artifacts were recovered from the Tiszapolgár graves at Vésztő-Mágor (Hegedűs 1977), and during our excavations at the Bikeri sites, we recovered a total of six small objects made of copper (see Chapter 13, this volume). These are the first recovered metal artifacts from Tiszapolgár domestic contexts, but their small number indicate that the communities of the Körös region had only limited access to not only lithic raw materials but also copper exchange networks.

Although a significant decline in long-distance exchange contacts occurred at the beginning of the Copper Age, interactions between dispersed Tiszapolgár communities in the Körös region and neighboring territories continued. Low-visibility stylistic attributes on ceramic vessels from various Early Copper Age villages throughout the study area exhibit uniform or random distributions. Parkinson (2006a) associated this pattern with processes that contributed to regional stylistic homogenization, such as the passive learning of decorating techniques or the relocation of people because of post-marital residence rules.

High-visibility stylistic elements show substantial, patterned differences in their frequency across the study region. Specifically, some highly visible attributes, such as linear-incised and dotted-incised decorations, exhibit a clinal decrease in abundance toward the eastern part of the Körös region (Gyucha 2015; Parkinson 2006a, 2006b; see also Chapter 4, this volume). We believe that instead of representing a clear "cultural" boundary, like that which actually seems to have separated the preceding Tisza and Herpály archaeological groups (Riebe 2016), this pattern is indicative of social boundaries that were more permeable and less actively maintained during the Early Copper Age than the Late Neolithic.

The clinal distribution of high-visibility stylistic elements, with a substantially higher frequency in the west than in the east, coincides with Bognár-Kutzián's (1972) territorial division within the Tiszapolgár culture. According to her model, which also was based on differences in ceramic types and decorations, the boundary between the Kisrétpart and Basatanya groups fell within our study area. However, contrary to Bognár-Kutzián (1972:189), the ceramic assemblages from Vésztő-Bikeri and Körösladány-Bikeri suggest that the so-called Kisrétpart ceramic style evolved not during the latest phase of the Early Copper Age but at the beginning of the period (see also Kalicz 1985b; Siklódi 1983).

Due to the homogeneity of clays in the study area, petrographic and chemical investigations of the ceramic assemblages were only moderately successful. However, they verified that some ceramics in Early Copper Age samples from the Körös region were manufactured in adjacent regions (Duwe 2005; Hoekman et al. 2006; see also Chapter 10, this volume). Elemental studies also suggest connections between sites located relatively far from one another; the results show that the communities of Vésztő-Bikeri and Battonya-Vertán, located about 75 km away, were linked, either directly or through down-the-line exchange. The same may be true for the villages of Körösladány-Bikeri and Örménykút-Maczonkai-domb, which are about 35 km apart as the crow flies. Stylistic, petrographic, and elemental studies, however, yielded no evidence for extensive, long-distance exchange of ceramics beyond those distances.

Conclusions: The Dawn of the Copper Age on the Great Hungarian Plain

The beginning of the Copper Age on the Great Hungarian Plain saw fundamental transformations in social and economic organization. The large, nucleated villages of the final stage of the Neolithic were abandoned, as were many other long-standing traditions. The distributions of Early Copper Age settlements and ceramic stylistic elements in the Körös region suggest that the more rigid, actively maintained social boundaries that separated groups such as the Tisza and Herpály during the Late Neolithic gave way to more permeable boundaries. The tell-centered settlement pattern was replaced with a more dispersed settlement system that linked small, sometimes fortified, villages to unfortified hamlets and the occasional large sites. Many Copper Age villages were established in areas that previously had been uninhabited, perhaps because they were located in ecologically unstable environments (prone to flooding or drought, for example). Although they were relocated more frequently than most Late Neolithic settlements, some Early Copper Age villages were occupied, or reoccupied, for several generations. These communities worked together to construct fortifications and bury their dead, some in the first formal cemeteries in Europe, and exchanged materials and goods with each other within the Körös region and beyond. Instead of the well-established long-distance trade networks of the Late Neolithic, where the tells operated as micro-regional nodes that linked the communities of the Carpathian Basin to adjacent and remote regions, Early Copper Age communities on the Great Hungarian Plain were plugged into decentralized interaction networks and exchange systems that were characterized by more intermittent relations.

All these changes occurred over several generations at varying tempos in different parts of the Great Hungarian Plain. This picture of a more gradual, regionally variable transformation at the end of the Neolithic is markedly different from previous models that characterized the transition to the Copper Age as temporally abrupt, geographically simultaneous, and far-reaching.

The fundamental sociocultural changes at the dawn of the Copper Age tend to overshadow the many continuities that linked the villagers of the Early Copper Age with their Neolithic predecessors. The rich alluvial plain of the branches of the Körös River system continued to attract settlers during the Copper Age, as it had since the beginning of the Neolithic, while the northern Maros Fan, featuring fertile soils but lacking active watercourses in the Holocene, remained only sparsely inhabited. Although many settlements were abandoned at the end of the Neolithic (or very early in the Copper Age), some settlements, such as the Vésztő-Mágor tell, were reoccupied during the Early Copper Age. Furthermore, many micro-regions in the Körös Basin that had been inhabited in the Late Neolithic continued to be occupied during the Early Copper Age, albeit with more dispersed and smaller sites and with less discrete and many times less durable social boundaries between micro-regional sociopolitical units.

The communities that established these Early Copper Age villages may have lived together in discrete household clusters within the large Late Neolithic settlements. Many of the techniques associated with house construction and the building of fortifications were not forgotten and continued to be used in the Copper Age. Although they hunted less frequently, the Tiszapolgár villagers also practiced many of the same farming and herding traditions they had refined during the Neolithic. While they made more pots with pedestalled bases and different kinds of decorations, many of the Neolithic traditions of ceramic manufacture also persisted into the Tiszapolgár period. Finally, although many of the deceased Early Copper Age villagers were buried in formal cemeteries, not everyone was afforded that privilege. The Neolithic tradition of interring the dead in unoccupied parts of the settlement also continued into the Copper Age, especially with infants and children.

This more subtle, fleshed-out model of how the Neolithic became the Copper Age in the Körös region permits us to evaluate some of the models that have been proposed to explain the end of the Neolithic in southeastern Europe. For example, we have found no evidence to support the model of an abrupt invasion of Proto-Indo-European raiders on horseback at the beginning of the Copper Age (Gimbutas 1977, 1982, 1991; Mallory 1989). Nor have we been able to identify evidence for violent conflicts between tell-based farmers and more mobile pastoral communities at the end of the Neolithic (Ecsedy 1981; Horváth 1989). The defensive enclosures constructed around Late Neolithic and Early Copper Age settlements suggest that interactions between the communities of the Great Hungarian Plain were not always peaceful during any of these periods. Nonetheless, the occurrence of violent conflicts cannot itself be invoked as an explanation for the social transformations at the end of the Neolithic.

Also lacking is adequate evidence for radical environmental changes around 4500 cal BC (Starkel 1995; Sümegi 2007; Weninger et al. 2009). A shift to a more arid climate that resulted in the development of mobile cattle pastoralism has been the most widely cited explanation for the Neolithic–Copper Age transition (e.g., Bánffy 1994; Bognár-Kutzián 1972; Bökönyi 1974; Ecsedy 1981; Horváth 2005; Kalicz 1966; Siklódi 1982, 1983). However, our studies illustrate that rather than an overall reliance upon domestic cattle, the Early Copper Age communities developed subsistence strategies that were adapted to local conditions. Although the Tiszapolgár faunal assemblages show an increase in the frequency of domesticates, the relative frequency of cattle, pigs, and ovicaprids varies from site to site. Moreover, the botanical remains from the subsequent Bikeri sites may indiciate an increase in the significance of farming over time, which conflicts with a general shift to a highly mobile way of life and pastoral economy during the Early Copper Age.

More difficult to assess are social factors such as scalar stress (Johnson 1982), which may have been just as important as environmental or economic changes in long-term social trajectories. According to many researchers (e.g., Horváth 1985; Kalicz 1988; Makkay 1982; Parkinson 2006a), population growth may have resulted in scalar stress within the egalitarian farming communities on the large, nucleated sites of the Late Neolithic on the Great Hungarian Plain. Some have argued that it is exceptional for more than 500 to 600 people to live together at any settlement without hierarchical regulatory mechanisms (Bintliff 2007; Kosse 2001). Thousands of inhabitants may have lived at some Late Neolithic tells and large horizontal settlements in southeastern Europe, yet there is little evidence for institutionalized hereditary inequality and ascribed ranking in the region until the Bronze Age (Anders and Raczky 2013; Müller 2006; Müller et al. 2011). After generations of living in close quarters in these large villages, relationships between households and neighborhoods may have become strained, and ultimately the Late Neolithic villagers chose to "vote with their feet" and create smaller, more dispersed sites during the Early Copper Age. Unfortunately, positive indicators of scalar stress are notoriously difficult to identify in the archaeological record.

In addition to social tensions and conflicts, the aggregation of a relatively large, and possibly growing, number of people during the Late Neolithic may have given rise to another ecological consequence: overexploitation. The exploitation of many natural resources likely was concentrated immediately around these large settlements. Some resources, such as arable land, are abundant in the Körös region and likely would not have been overexploited, even with substantially higher population densities (Duffy 2014). But other resources, including critical ones such as wood, likely could not have been renewed quickly enough to keep pace with their consumption by such large communities (Gyucha et al. 2009; Raczky and Anders 2009). Recent paleoecological data from the Great Hungarian Plain indicates that forest clearance had reached its peak by the end of the Neolithic (Magyari et al. 2012; Sümegi et al. 2005) and that Copper Age farmers elsewhere were experimenting with innovative crop management techniques, such as coppicing or pollarding (Gardner 2002). The highly dispersed spatial distribution of Early Copper Age settlements and the occupation of previously uninhabited areas in the Körös region suggest that fundamentally different regional land-use strategies were being adopted and experimented with, possibly as a response to overexploitation.

Precise understanding of the specific causes that ushered in the beginning of the Copper Age requires additional results from new investigations. Nevertheless, the more nuanced model we have proposed here, which operates successfully at many different geographic and temporal scales, goes a long way toward explaining a large amount of the variation in practices and material culture associated with the transition from the Late Neolithic to the beginning of the Copper Age. Indeed, perhaps one of the most significant findings of our studies has been an appreciation for the incredible amount of temporal and geographic variation in socioeconomic developments during the onset of the Copper Age. Thanks in large part to the increasing proliferation of systematic, regional-scale archaeological projects, as well as advances in radiocarbon dating and chemical studies, we are now beginning to grasp the subtle differences that characterized regional and micro-regional trajectories of long-term social change. By building upon the long and strong tradition of archaeological excavation and survey in southeastern Hungary—and especially the MRT project—we have had the unique luxury of designing and implementing a research project that operates at these multiple temporal and geographic scales and that, to our immense satisfaction, has led to many parallel research projects, which we hope will eventually lead to a clearer understanding of the magnificent prehistory of the Körös region and, ultimately, to a better understanding of the prehistory of the European continent.

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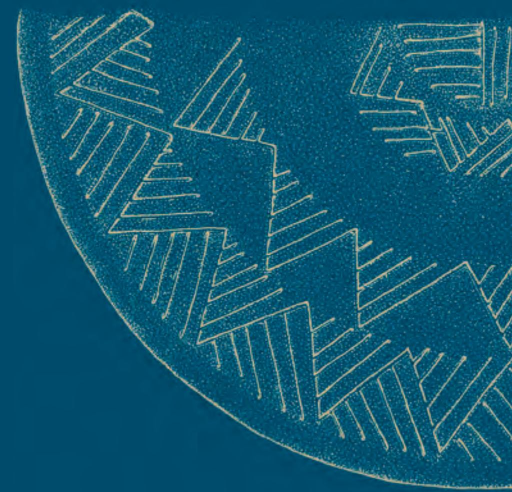

BIKERI
Two Copper Age Villages
on the Great Hungarian Plain

The transition from the Neolithic to the Copper Age in the northern Balkans and the Carpathian Basin was marked by significant changes in material culture, settlement patterns, and mortuary practices that indicate fundamental social transformations in the middle of the fifth millennium BC.

This volume presents the investigations by the Körös Regional Archaeological Project in southeastern Hungary from 2000 to 2007. Centered around two Early Copper Age villages in the Körös region of the Great Hungarian Plain, Vésztő-Bikeri and Körösladány-Bikeri, research incorporated excavation, surface collection, geophysical survey, and soil chemistry to explore settlement layout, organization, and development. The adjacent villages were similar in size, were protected with fortifications, and both were likely occupied by the same community. This settlement relocation after only a few generations broke from the longer-lasting patterns typical of the Late Neolithic, but other aspects of the Bikeri villages demonstrate continued traditions from the preceding period, including the construction of enclosure systems and longhouses.

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Front: Bowls with incised decoration from Vésztő-Bikeri.
Drawing by Dorottya Kékegyi and Jill Seagard.

Above: Antler tine arrowhead from Vésztő-Bikeri.
Photograph by Barrett Doran.

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