

Diet and subsistence at the late Neolithic tell sites of Sopot, Slavča and Ravnjaš, eastern Croatia

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ABSTRACT – *This paper presents archaeobotanical data from three late Neolithic Sopot Culture (c. 5200–4000 cal BC) tell sites, Sopot, Slavča and Ravnjaš, located in eastern Croatia. Tell settlements are well suited for exploring aspects of diet and subsistence, as they present a concentrated area with successive generations building upon previous occupation levels. The plant remains from the three study sites suggest a crop-based diet of mainly einkorn, emmer, barley, lentil and pea, as well as evidence of crop-processing activities. This diet was also probably supplemented by wild fruit from the local environment, such as cornelian cherry, chinese lantern and blackberry.*

KEY WORDS – *crop agriculture; archaeobotany; crop processing; charred macro-remains*

Prehrana in preživetje na poznoneolitskih najdiščih Sopot, Slavča in Ravnjaš na vzhodu Hrvaške

IZVLEČEK – *V članku predstavljamo arheobotanične podatke iz treh poznoneolitskih najdišč sopske kulture (ok. 5200 do 4000 pr. n. št.), in sicer na najdiščih Sopot, Slavča in Ravnjaš, ki so naselbine tipa tell na vzhodu Hrvaške. Naselbine tipa tell so primerne za preučevanje različnih aspektov prehrane in sredstev za preživetje, saj predstavljajo zgoščena območja, kjer so naslednje generacije gradile neposredno na predhodne poselitvene plasti. Rastlinski ostanki in dokazi o aktivnostih, povezanih s predelavo poljščin, kažejo na vseh treh najdiščih na prehrano, ki je temeljila na poljščinah kot so enozrnica, dvozrnica, ječmen, leča in grah. Prehrano so verjetno dopolnjevale še divje rastline iz lokalnega okolja kot so rumeni dren, navadno volčje jabolko in navadna robida.*

KLJUČNE BESEDE – *poljedeljstvo; arheobotanika; predelava poljščin; zogleneli makro ostanki rastlin*

Introduction

Agriculture is intrinsically linked with Neolithic society, as this was the period when domesticated plants and animals were first introduced, gradually changing the way people lived throughout Europe (see *Özdoğan 2014* for recent summary). By living in permanent settlements new ways of social organisation would have emerged and developed, including activities linked with crop agriculture, storage and food preparation.

Tells first appeared in the Balkans by the late Neolithic (c. 5200–4000 cal BC) alongside typical horizontal settlements common in the early Neolithic (c. 6000–5300 cal BC). Since the 1950s, tell sites in northern Serbia such as Selevač (*Tringham, Krstić 1990; McLaren, Hubbard 1990*), Divostin (*McPherron, Srejović 1988*), Gomolava (*Jovanović 1988; Van Zeist 2003*), Vinča (*Chapman 1981; Filipović, Tasić 2012*) and

Opovo (Tringham et al. 1985; 1992; Borojević 2006), and in Bosnia and Herzegovina, such as Okolište (Müller et al. 2013), have provided archaeobotanical datasets that can be used to examine agricultural practices in the region. This is crucial if we are to understand the development of societies during the Neolithic. Unfortunately, the preservation and the absence of sufficient numbers of weed seeds and chaff remains has posed many problems in the interpretation of past human activities at these sites, e.g., crop processing and crop husbandry regimes (see Hillman 1981; Jones 1984; Van der Veen 1992; Bogaard 2004), and so many questions remain.

Tell settlements are very useful for exploring aspects of diet and subsistence, as they present a concentrated area with successive generations building on previous occupation levels. However, in Croatia, few tell sites have been excavated and even fewer have conducted archaeobotanical recovery programmes. To date, only five other late Neolithic settlements have yielded archaeobotanical remains from eastern Croatia: Bapska-Gradac (Burić 2007.45–46), Otok (Obelić et al. 2002), Ivandvor-Gaj, Tomašanci-Palača and Brezovljani (Reed 2015). Both Otok and Bapska-Gradac are tell sites; however, the only published remains from Otok consisted of a single grain of bread wheat (*Triticum aestivum*) ¹⁴C dated to 4620–4350 cal BC; while the archaeobotanical results from Bapska are not yet forthcoming, both emmer (*Triticum dicoccum*) and einkorn (*Triticum monococ-*

cum) have been identified. From the remaining sites, the plant remains suggest that glume wheats, emmer and einkorn, barley (*Hordeum vulgare*), lentil (*Lens culinaris*), pea (*Pisum sativum*) and flax (*Linum usitatissimum*) were all commonly grown (Reed 2015). This paper presents the archaeobotanical results from the late Neolithic tell sites at Sopot, Slavča and Ravnjaš, exploring activities linked with crop agriculture, storage and food preparation at the settlements.

The Late Neolithic in eastern Croatia

The Sopot Culture developed on the foundations of the late Starčevo Culture. It has been suggested that the central area of the classic Sopot Culture is located in the region of eastern Slavonia, between the Drava, Sava and Danube rivers (Marković 1994.82). Settlements were often raised on natural elevations on the banks of rivers and streams, such as Sopot, Vinkovci, Privlaka, Orolik, Gaboš, Marinci, or on swampy, flood plains, close to extinct streams, such as at Stari Mikanovci, Otok, Komletinci, Retkovci (Krznarić Škrivanko 2012.37). The Sopot culture also expanded into Hungarian Transdanubia (Bánffy et al. 2016.290) and northern Bosnia between the Vrbas and Tinja rivers (Dimitrijević 1979.334). A characteristic feature of this culture is black polished biconical and S-profiled vessels, but ceramics were generally undecorated, with only a small percentage being decorated with shallow carvings and tally ornamentation.

Archaeologists divide the Sopot culture into three phases; early (I), middle (II) and late (III). Although, Dimitrijević (1968) subdivided the oldest phase into 2 stages (I-A, I-B), while newer investigations at the eponymous site of Sopot distinguish II-A and II-B stages (Krznarić Škrivanko 2002), as well as a final horizon of the early Eneolithic (phase IV – the Seče type of the Sopot Culture) (Mihaljević 2013), parallel with the Lengyel III and Tiszapolgar cultures (Marković 1985). Recent carbon-14 dating of Sopot Culture sites date Phase I-B to a period between 5480 and 5070

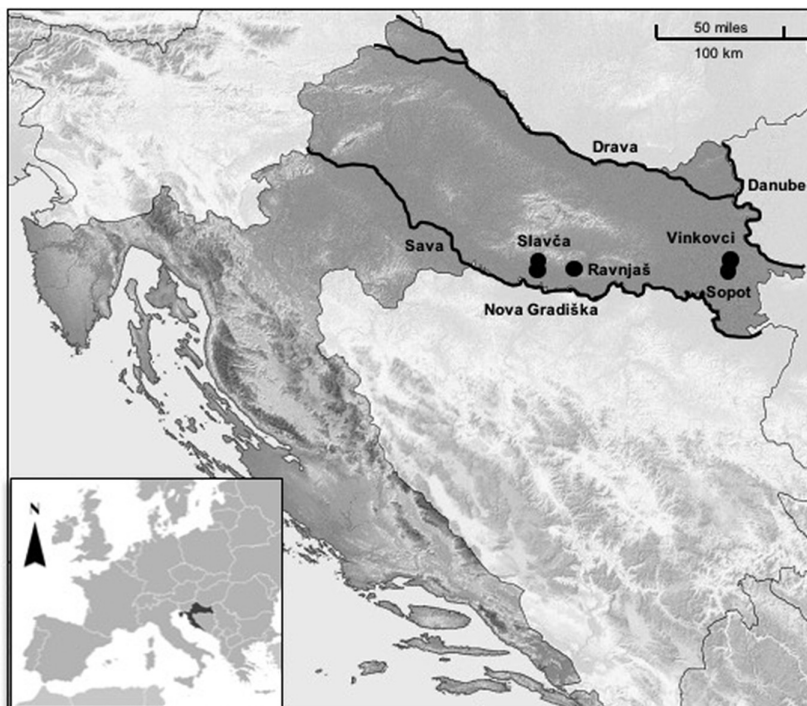


Fig. 1. The Late Neolithic tell sites of Sopot, Ravnjaš and Slavča.

cal BC, Phase II-A between 5030 and 4770 cal BC and Phase II-B between 4800 and 4250 cal BC (*Obešlić et al. 2004.Tab. 3*). The earliest series of dates for Phase IV is between 4340 and 3790 cal BC (*Krznarić Škrivanko 2009; Mihaljević 2013*).

Site descriptions

Sopot

Sopot is situated 3km south-west of Vinkovci, on the right bank of the River Bosut (Fig. 1). The tell site is elliptical, measuring 113 x 98m, and is 3m deep. Sopot was first identified by J. Brunšmid in 1902 (*Brunšmid 1902.121*) and later excavated by M. Klajn in the late 1930s (*Klajn 1961.22*). In 1967, Stojan Dimitrijević led archaeological test-pit excavations at Sopot and took the site of Sopot as the eponym for this cultural phenomenon (*Dimitrijević 1979.264*). The most recent systematic excavations at Sopot were conducted between 1996 and 2008 by Vinkovci Municipal Museum. A total of 376m² was excavated from a section 37m long transecting the settlement, beginning in the south-west corner (*Krznarić Škrivanko 2000; 2003; 2011*).

Three phases of Late Neolithic Sopot culture have been identified at the site, as well as an early Neolithic Starčevo settlement ¹⁴C dated to 6060–5890 cal BC (*Krznarić Škrivanko 2011*). Two fortified ditches are evident (Fig. 2); an older one of 100 x 80m dates to the early Sopot settlement, which was later filled and replaced by a ditch surrounding an area of 120 x 100m (*Krznarić Škrivanko 2003; Mušič et*

al. 2011.85). The oldest house, excavated above the first ditch and dating to 5050–4780 cal BC (*Obešlić et al. 2004.252–253*), was rectangular, with an area of 6.70 x 4m, and had evidence of internal room divisions (*Krznarić Škrivanko 2003; 2006*). The youngest house, ¹⁴C dated to 4340 and 3997 cal BC (*Obešlić et al. 2004.249*) is a typical Neolithic rectangular house, measuring 6 x 4m (*Krznarić Škrivanko 1998.31*). Pottery analyses date this phase to the Copper Age, Sopot IV (*Balen 2005; Krznarić Škrivanko, Balen 2006*), and at this time numerous canals appeared (*c.* 4250 and 4030 cal BC), which destroyed some of the earlier house floors (*Krznarić Škrivanko 2009*). Building cycles at the site were often characterised by the burning of an old house, which was then covered with a layer of soil before a new house was constructed. Excavations have shown that most houses were built in the same place as older ones, with small horizontal shifts.

Slavča

The prehistoric site of Slavča is located approx. 1.5km north of the centre of Nova Gradiška. The site is a fort type, on a flat plateau at the point where the southern slopes of Psunj exceed the Posavina Plain. At an elevation of 240.61m, it offers a strategic position commanding the surrounding area (Fig. 3). The site was first identified in 1907 by the conservator Đuro Szabo. Systematic archaeological excavations by the Department of Archeology, Filozofski fakultet Zagreb (*Vrdoljak, Mihaljević 1999*) started in 1997, and were taken over in 1999 by the Municipal Museum of Nova Gradiška until 2013 (*Mihaljević 2000; 2004; 2005; 2006; 2007; 2008; 2009*).



Fig. 2. Detailed magnetic survey of Sopot, including the position of the 1996–2008 excavation trenches in the bottom left of the settlement. Courtesy of Vinkovci Municipal Museum.

The site is a multilayered prehistoric settlement with Sopot and Brezovljani type Sopot culture occupation, illustrating the transition from the late Neolithic to the early Eneolithic (Sopot IV), Lasinja, Kostolac and Vučedol culture (*Skelec 1997*). Surveys have revealed segments of the settlement with sectional pit objects, some of which are living, working, storage and waste pits and defensive ditches. Finds include pottery, loom weights, whorls for fishing nets, and stone and chipped artefacts (*Šošić, Karavanić 2004*). Zooarchaeological analyses showed a predominance of cow, sheep/goat and pig remains, with little evidence of hunting (*Mi-*

culinić, Mihaljević 2003). Recent ^{14}C dates of the Sopot levels include 5210–4950 cal BC, from a pit with no ceramics, and 4960–4340 cal BC, as well as 4250–4030 cal BC associated with Sopot IV (Mihaljević 2013).

Ravnjaš

Ravnjaš is located on the upper slopes of the Pože-ga hill, north-west of the village of Nova Kapela. Excavations by Nova Gradiška Municipal Museum were carried out between 2006 and 2008, revealing a phase II Sopot Culture tell settlement (Mihaljević 2006; 2007; 2008). A series of pit objects and a house (SJ022) were discovered. The rectangular house was oriented north-south, consisting of two rooms containing a large amount of burnt material and large quantities of household items, including millstones, pottery and lithics. In addition, a fireplace of baked clay was discovered at the entrance to the house. Recent ^{14}C dates indicate a range of 4970 to 4690 cal BC (Mihaljević 2013).

Material and methods

Sampling and recovery

Between 2006 and 2008, 71 samples were collected from a range of contexts from Sopot culture occupation levels at Ravnjaš. At Slavča, 63 samples were collected from contexts associated with a Sopot culture settlement, although seven of the samples were identified as mixed with Lasinja and Kostolac culture material. Sample sizes were not recorded, but a minimum of one bucket (approx. 11 litres) of sediment was collected where possible for each sample. The samples were later processed by bucket flotation using 1mm and 300 μm mesh sizes. At Sopot, 144 samples were collected between 1999 and 2008 from a range of contexts, including house floors, pits, a ditch and hearths. The samples were processed by machine flotation, using 1mm and 250 μm mesh sizes. Volumes were only partially recorded, but 1–2

buckets (up to approx. 20 litres) per sample were collected where possible.

Sorting and species identification

The flot remains were 100% sorted, except for two at Slavča (Tab. 1 is available online at <http://dx.doi.org/10.4312/dp.44.19>), and their charcoal volumes were recorded. Carbonised plant taxa were identified with a low power (7–40x) binocular microscope and comparisons made from modern reference collections at the Institute of Archaeology, UCL and the School of Archaeology & Ancient History, University of Leicester.

Identifying the cereal remains at the sites was particularly difficult in some instances due to poor preservation and overlaps in morphology. A few possible rye grains (*cf. Secale cereale*) and spelt glume bases (*Triticum spelta*) had already been identified at Sopot, but they were fragmentary and inconclusive, so they have now been reclassified as cereal indet and *Triticum* sp. In addition, grains of broom-corn millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*), were also misidentified at all three sites, mainly due to poor preservation and similarities in morphology between foxtail millet and barnyard millet (*Echinochloa crus-galli*), which both have a scutellum extending over approx. two thirds of the grain length. Here the grains had a wider embryo, a flatter apex and an ovoid hilum more commonly seen in barnyard millet (Fig. 4i).

Of particular note in the assemblages was the identification of two-grained einkorn at Sopot, and both the grain and chaff of the ‘new type’ glume wheat at all three sites (Jones et al. 2000; Kohler-Schneider 2003; Kenéz et al. 2014). Two-grained einkorn was identified based on the observations of Helmut Kroll (1992) and Angela Kreuz and Nicole Boenke (2002). The one grain was slightly smaller and narrower in shape compared to emmer, with a flat ventral surface and a distinctive ventral compression near the pointed apex (Fig. 4c).

The identification of the ‘new type’ of glume wheat grains and glume bases was based on observations made by Glynis Jones et al. (2000) and Marianne Kohler-Schneider (2003). The grains were distinctly more slender than the emmer grains, and in the lateral view were distinctly ‘flat’, with a more rounded apex and narrower embryo. The dorsal



Fig. 3. The prehistoric site of Slavča (photo by Marija Mihaljević).

view was also generally more straight and parallel compared to the emmer grains, which were wider above the embryo (Fig. 4a). Identification of the glume bases were seen from a narrower and deep attachment scar, with a prominent primary keel projecting vertically when viewed from the abaxial face, like einkorn. The secondary keel was also prominent, as in einkorn, but sharply angled, unlike einkorn, in which it is rounded, with a clearly defined vein running along the keel, unlike either emmer or einkorn. These glume bases were also particularly distinct from those of emmer and einkorn, as they seemed more robust (Fig. 4f, g).

Many of the samples were collected from the same context, so the samples from the same trench, stratigraphic unit (SJ) and square were combined (Tabs. 1–3 are available online at <http://dx.doi.org/10.4312/dp.44.19>). All grains were counted as one, even if only a fragment was present. Glume base fragments were counted as one unless clearly representing part of another glume base, while whole spikelet forks were counted as two glume bases. The fruit and weed seeds were counted as one, even when only a fragment was found, except where large seeds were broken and clearly represented the same parts of the same seed (*e.g.*, *Cornus mas*).

Site formation and the interpretation of the plant remains

In order to understand the archaeobotanical results, it is important to explore the formation processes at the site, so as to identify any possible bias in the samples that may influence interpretations. The plant remains at Sopot, Slavča and Ravnjaš were preserved through carbonisation or charring, which results from organic material being exposed to heat either accidentally or deliberately, such as cooking, burning rubbish or fuel (*Hillman 1984; Miller, Smart 1984; Charles 1998; Valamoti, Charles 2005; Van der Veen 2007*). Thus, the charred remains represent only a small and biased sample of the edible plants probably utilised by the late Neolithic settlements. These ‘missing foods’ mean that our ability to establish the composition and overall contribution of plants to the diet is inherently biased towards charred remains that come into contact with fire more frequently and survive the charring process (*Dennell 1972; Hillman 1981; Jones 1981; Boardman, Jones 1990; Van der Veen 2007*).

The deposition of these remains within the archaeological record also needs to be considered, and the

groups proposed by Richard N. L. B. Hubbard and Alan J. Clapham (*1992*) provide a simple way to classify samples: Class A, where remains have been burnt and recovered in-situ; Class B, where remains derive from a single burning event, but were moved (secondary deposition); and Class C, where the assemblage derives from different charring events that were subsequently deposited within the same context. In addition, seed density can be used to reflect the rate of deposition. For example, a low density of plant remains could indicate the slow accumulation of charred items that originated from different burning events, unassociated with the feature in which they are finally deposited (*Miksicek 1987; Jones 1991*). Charred plant remains can also survive for long periods, and archaeobotanical evidence has shown cases of older plant remains being redeposited within younger contexts (*e.g.*, *Pelling et al. 2015*).

Preservation was generally poor at the study sites, with many of the plant remains being identified through gross morphology only. In total, the three sites contained over 9000 unidentifiable plant fragments and over 1100 unidentifiable cereal fragments. Charcoal density per litre was also generally low, with a mean density of 0.20cm³ at Sopot, 0.24cm³ at Ravnjaš and 1cm³ at Slavča. The mean seed density per litre was also generally low at Sopot and Ravnjaš, 1.1 and 2.8 seeds per litre. However, at Slavča the mean seed density was 15 seeds per litre. This was due to extremely high numbers of glume wheat glume bases in a number of the samples (see below for further details). The low density of plant remains within the contexts suggest a slow accumulation deriving from different charring events, while the high densities seen at Slavča may suggest plant remains deposited from a single burning event (*e.g.*, SJ123 and SJ7). Only the hearths showed evidence of in-situ burning; however, multiple burning episodes would have occurred within these contexts. Thus, the samples from all three sites probably result from Class C remains, where the assemblages derived from different charring events were later deposited within the same context.

In addition, the overall assemblage from the three sites shows that samples from house floors or occupational levels have a higher percentage of grain and fruit remains, while those samples recovered from pit, ditch or other external settlement features are more likely to contain chaff remains (Fig. 5). Thus, the high percentage of cereal grains and fruits within house and hearth features may suggest the preparation of food for human consumption. While,

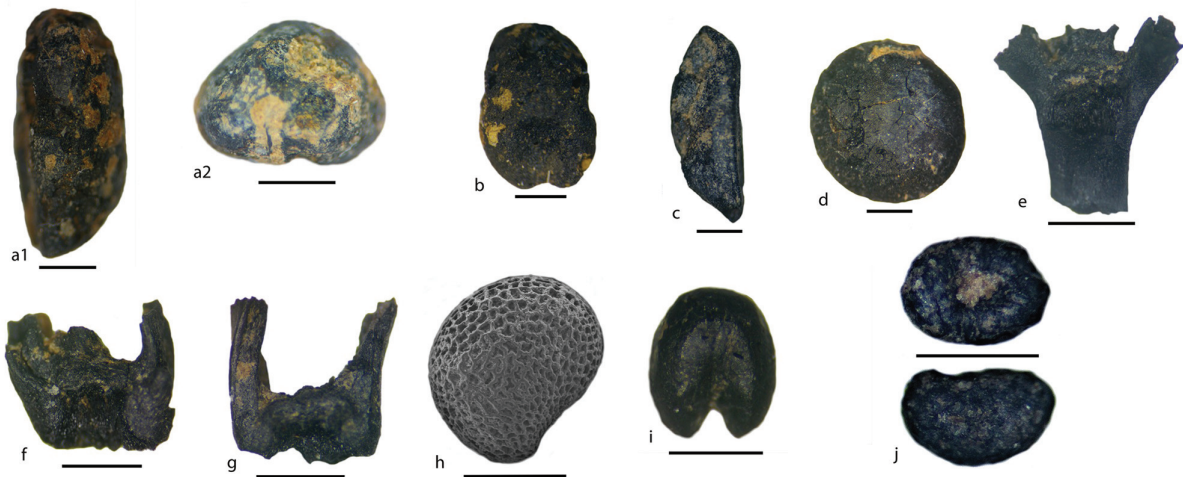


Fig. 4. Carbonised seeds from the study sites: a1–a2 ‘New type’ glume wheat; b naked wheat (*Triticum aestivum/durum*); c Two-grained einkorn (*Triticum monococcum*); d Lentil (*Lens culinaris*); e Barley rachis (*Hordeum vulgare*); f ‘New type’ glume wheat glume base; g Emmer glume base (*Triticum dicoccum*); h Chinese lantern (*Physalis alkekengi*); i Barnyard millet (*Echinochloa crus-galli*); j Hedge bedstraw (*Gallium sp. mollugo*). Scale bar: 1mm.

the high chaff content (mainly glume wheat glume bases) within pits and ditches may result from the deposition of crop processing waste (see below for more details).

Crop husbandry: Which crops were grown

Only five types of cereal grain and chaff were identified from the three sites: barley, emmer, einkorn, ‘new type’ glume wheat and naked wheat. Of these five, emmer and einkorn dominate the samples both in quantity (Fig. 6) and the frequency with which they are found in the different contexts. This is similar to remains found at Neolithic sites in Albania (*Xhuveli, Schultze-Motel 1995*), Bosnia and Herzegovina (*Renfrew 1979; Kučan 2009*), northern Italy (*Rottoli, Castiglioni 2009*), Serbia (*Filipović, Obradović 2013* for summary) and Slovenia (*Tolar et al. 2011*).

It is particularly interesting to note the large quantities of glume bases recovered, amounting to nearly 6000 from the three sites, compared to only around 1200 grains, and what this may say about subsistence practices at the sites. For example, since the 1970s, researchers have determined that carbonised plant remains are more likely to result from food production and crop processing rather than from food consumption, and therefore provide a record of the crop husbandry and processing methods employed (*Knörzer 1971; Dennell 1972; 1974; 1976; Hillman 1984; Jones 1984*).

Predictive models have since been created to identify which stage of the crop processing sequence an

archaeobotanical assemblage represents. This is based on the assumption that each stage produces a characteristically different ratio of cereal, chaff and weeds within the sample (*Hillman 1984; Jones 1984; Van der Veen 1992; Van der Veen, Jones 2006*). Each stage produces two assemblages: a crop product, which continues through each stage, and a crop by-product or residue, which is removed from the remaining processes. Simplified, the stages for processing free-threshing cereals (e.g., naked wheat and barley) are as follows (after *Hillman 1984; Van der Veen 1992*):

- harvesting: to gather the mature crop from the field, possibly by uprooting or cutting the grain-bearing part of the plant;
- threshing: to release the grain from the chaff, possibly by beating with a stick or trampling by cattle;
- winnowing: to remove the light chaff and weeds from the grain, possibly by wind or by shaking in a winnowing basket;
- coarse sieving: to remove larger items such as weed heads, seeds, un-threshed ears and straw with large meshes;
- fine sieving: to remove the small weed seeds from the grain with narrower meshed sieves.

Glume wheats (e.g., einkorn, emmer and ‘new type’ glume wheat) on the other hand require further processing stages to release the grain from the tight glumes. The additional processes involved in the de-husking of glume wheats are as follows (after *Hillman 1984; Van der Veen 1992*):

- processing stage Rationale;
- parching to dry the grain and render the glumes brittle;
- pounding to release the grain from the glumes, possibly in a wooden mortar or quern;
- second winnowing to remove light chaff and weeds from the grain;
- second coarse sieving to remove the remaining large items, such as unthreshed ears or chaff and remaining culm nodes and large weeds in heads;
- second fine sieving to remove glume bases and remaining small weed seeds.

Put simply, this suggests that a sample with high numbers of cereal grains and not much else, which resulted from one burning and depositional event, would represent the end of the crop processing stages when the grain is ready for consumption. On the other hand, a sample with a high number of glume bases, also resulting from one burning and depositional event, probably represents crop processing waste (*i.e.* where the chaff is removed from the grain).

Examining the study sites, it is clear that many of the samples with low densities resulted from a range of different charring events. However, the high densities seen at Slavča in stratigraphic units 123 and 7 and the fact that over 75% of the samples were made up of glume wheat glume bases may suggest evidence of crop processing waste (see also Reed 2015) dumped after being carbonised elsewhere. Some suggest that the daily processing of stored glume wheats occurred within the household, where the waste (cereal chaff) was then swept into fires and carbonised (*cf.* Hillman 1984; Gregg 1989; Meurers-Balke, Lüning 1992; Bogaard 2004.68; Kreuz 2012). The waste from these fires could have then been deposited outside the houses in pits or ditches around the settlement, so SJ123 and SJ7 may indicate the secondary or tertiary deposition of discarded wheat chaff. If this is the case, then it is likely that the recovery of both einkorn and emmer in the samples represent individual crop remains, rather than crops being grown together (Jones, Halstead 1995), especially as recent research suggests that emmer and einkorn ripen at different times if sown simultaneously (Kreuz, Schäfer 2011). Furthermore, archaeological finds of querns and flint sickle blades also attest to crop processing activities at the sites. The recovery of less than ten barley rachis at Slavča and Sopot and the absence of barley at Ravnjaš may suggest that barley was mainly processed away from the settlement, or was only a minor crop at the sites. However, cereal rachis is more fragile than glume

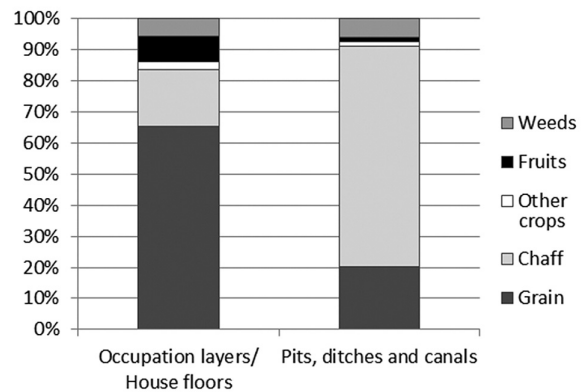


Fig. 5. Percentage of seeds in each plant category per context group for all three sites.

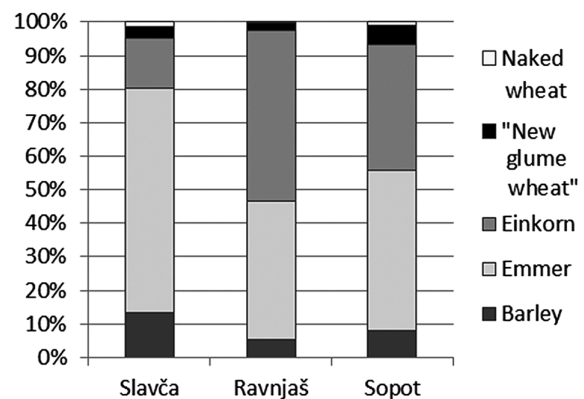


Fig. 6. Number of grain and glume bases per species at each site (where 1:1 barley rachis/grain; 2:1 einkorn glume base/grain; 1:1 emmer and 'new type' glume wheat:grain).

bases and may simply have not survived the carbonisation process, resulting in its under-representation at the sites (*cf.* Dennell 1976; Hillman 1981; Boardman, Jones 1990).

The possible cultivation methods (*i.e.* manuring, weeding or irrigating) of the crops was not examined, due to the low numbers of weed seeds recovered from the study sites, as well as the limited identification of seeds to species level (see Bogaard 2004; Kreuz, Schäfer 2011 for examples of examining cultivation methods of crops at Neolithic sites in central Europe).

Other crops

Lentil (*Lens culinaris*) was the most common pulse crop present at Sopot, Slavča and Ravnjaš. Pea (*Pisum sativum*) was also recovered from Ravnjaš and Sopot, as well as small quantities of grass pea (*Lathyrus sativus*) from Sopot, and bitter vetch (*Vicia ervilia*) from Ravnjaš. Pulse preservation through carbonisation can be under-represented in the archaeological record, but these four species are found con-

tinuously from the early Neolithic onwards in Central and Southeast Europe (Zohary et al. 2012.75). Therefore, it is likely that lentil was commonly grown at the study sites, with the addition of pea at Ravnjaš and Sopot.

Small quantities of flax seeds were identified from Sopot and Slavča. As one of the founder crops, flax is found throughout Southeast and Central Europe from the Early Neolithic onwards and is traditionally used for its oil (linseed) and/or fibres (Zohary et al. 2012.101). The high oil content in flax seeds can make them more susceptible to burning and less likely to be preserved compared to other seeds (Wilson 1984) and so their presence even in small numbers could suggest flax cultivation for oil and/or fibre. This is further supported by the recovery of flax textile fragments from the contemporary late Neolithic site at Opovo in Serbia (4700–4500 cal BC) (Borojević 2006; Tringham et al. 1992).

Crop storage at the tell sites

Year-round occupation of a site almost certainly required some kind of storage facilities for food and fodder. Storage is therefore a mechanism to buffer against seasonal and/or long-term variability in the food supply (Halstead, O'Shea 1989). Similarly, the larger the settlement, the more reliance would be placed on stored cereals and pulse crops (Halstead 1996.304). The location and size of storage facilities can reveal household behaviours, e.g., domestic storage for domestic use, external storage for communal use or excess goods for exchange. Therefore, the location of storage inside or outside the house or choosing communal storage is also related to the social and economic organisation of the site as a whole (Halstead 1999). However, direct evidence for storage practices by prehistoric farmers is rarely seen, due to the poor preservation of organic material and the fact that stored food, unless accidentally burnt in a catastrophic event, would have been consumed. Further problems arise when storage facilities are re-used for other purposes, such as repositories for domestic refuse or human burials. Therefore, the identification of prehistoric storage facilities is usually based on indirect evidence from architectural remains.

From the study sites in Croatia, few houses show evidence of internal storage pits; however, at late Neolithic Sopot, the well-preserved remains of house 23 revealed large vessels ('buda' type), that could have been used for crop storage (Krznarić Škrivan-

ko 2003). This is comparable to the neighbouring Vinča culture settlements which also contained large immobile and slightly smaller mobile storage vessels within many of the houses (Stevanović 1997). External pits close to the houses at the study sites have also been excavated, and many contained low quantities of plant remains, although the remains do not necessarily indicate storage, as they may have been deposited as waste. Nevertheless, it is probable that both internal and external crop storage was practiced at the Neolithic sites to support the year-round occupation of them.

Other sources of food

In addition to cultivated crops, a number of other edible species were recovered, which would indicate the continued exploitation of the local environment. This includes cornelian cherry (*Cornus mas*) and Chinese lantern (*Physalis alkekengi*) at Slavča and Sopot, and blackberry (*Rubus fruticosus*) at Ravnjaš and Slavča. Of particular note at Sopot was a relatively large deposit of over 100 seeds of Chinese lantern found in the floor of one of the houses, which may suggest its deliberate collection by the household. It is difficult to assess the role of wild plants in prehistoric farming communities, but it is likely that they played an important role in subsistence (College, Conolly 2014), complementing not only human diet, but also contributing to many other aspects of human life, being used as building materials, medicines, dyes, fuel, animal fodder, crafts or rituals. Edible species found at the study sites may have included the seeds of fat hen (*Chenopodium album*) and the leaves of nettles (*Urtica dioica*). However, the small number of seeds found makes any further interpretation difficult. In addition, many of the weeds recovered from the study sites are commonly found as weeds in cultivated crops. For example, Bandkeramik weed species found regularly in samples associated with manured crops include *Bromus secalinus*, *Chenopodium album*, *Galium aparine*, *Galium Spurium*, and *Polygonum convolvulus* (Krueze, Schäfer 2011). A number of these genus and species are also found at the study sites, making it likely that many of the wild species are in fact weeds from the crops rather than collected wild foods.

Conclusion

Archaeobotanical remains collected from the late Neolithic tell sites at Slavča, Ravnjaš and Sopot indicate a crop-based diet of mainly einkorn, emmer, barley, lentil and pea. The plant-based diet of the

settlements also included wild fruits such as cornelian cherry, Chinese lantern and blackberry. However, the charred remains represent only a small and biased sample of the edible plants probably exploited by the late Neolithic settlements.

An examination of crop-processing activities at the sites suggest that emmer and einkorn grains were semi-cleaned before reaching the site and then processed further on a daily basis to remove the chaff and any remaining weed seeds. The early removal of weeds offsite would also have allowed seed corn to be stored relatively clean, which when sown would reduce weed growth and maintain economic crop yields (Dennell 1974). The charring of emmer and einkorn chaff may also indicate the parching of spikelets before processing, but could also result from the occasional use of processing residue as fuel (Hilman 1981; Van der Veen 2007).

The low seed densities at the sites had a distinct impact on the level of analysis that could be conducted. Thus, further research is needed to build on these results and to improve our understanding of agriculture and the role agriculture played in underpinning social, cultural and economic changes in the late Neolithic in eastern Croatia.

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