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## WOOL ECONOMY DURING THE EUROPEAN BRONZE AGE

### ABSTRACT

A number of studies over the last decades have considerably increased our knowledge about production and trade of woollen textiles during the Bronze Age in the Near East, the Aegean, and continental Europe. In the wider Mediterranean area, thanks to the abundance of available evidence, it has been possible to use the con-

cept of wool economy as a frame of reference to define the complex mechanisms behind production and trade of wool. The main aim of this paper is to reflect upon using the concept of wool economy to enhance our understanding of the relevant archaeological evidence from Bronze Age continental Europe.

### STRESZCZENIE

#### GOSPODARKA WEŁNĄ W EPOCE BRĄZU W EUROPIE

W ostatnich latach znacząco wzrosła wiedza o produkcji wełny oraz handlu i znaczeniu ekonomicznym tekstyliów wełnianych na Bliskim Wschodzie, w Egipcie i Europie kontynentalnej w epoce brązu. W odniesieniu do licznych pozostałości z obszaru basenu Morza Śródziemnego, możliwe stało się wprowadzenie koncepcji gospodarki wełną, która stanowi ramy

badawcze dla zdefiniowania złożonych mechanizmów decydujących o wymiarze produkcji i handlu wełną oraz wyrobami wełnianymi. Celem niniejszego artykułu jest próba odpowiedzi na pytanie, czy podobna koncepcja może mieć zastosowanie w odniesieniu do produkcji włókienniczej i wykorzystania wełny na obszarze Europy kontynentalnej.

**Keywords:** textiles, sheep/goat herding, textile tools, wool production, wool trade, craft specialisation, gender

### Introduction

Studies on wool production and trade during the European Bronze Age have grown in number over the last years (*e.g.* Bender Jørgensen, Rast-Eicher 2016; Frei *et al.* 2015; 2017; Gleba 2008; Grömer *et al.* 2013; Kristiansen 2016; Rast-Eicher, Bender Jørgensen 2013; Sabatini *et al.* 2018). Among other things, they have demonstrated that wool as a raw material for the production of textiles was used already at the dawn of the 2<sup>nd</sup> millennium BCE (*e.g.* Bender Jørgensen, Rast-Eicher 2015; 2018; CinBa database; Gleba, Mannering 2012), and that by the 14<sup>th</sup> century BCE long-distance trade of woollen textiles also existed (Frei *et al.* 2015; 2017). However, the role of wool in the development of the economic and social organisa-

tion of European Bronze Age societies has not yet been addressed in a comprehensive manner. Bronze Age textile production in general and, as per the scope of this work, wool manufacturing in particular, are a complex and time-consuming endeavour (*cf.* Costin 2013). As it will be discussed in more detail in the following paragraphs, wool manufacturing requires specialisation, resource management, and long-term planning. It seems therefore hardly manageable without some form of political economic design and the interplay of a number of different factors. The aim of this paper is to explore the premises required for the rise of wool economy to be observable in the archaeological record from Bronze Age Europe. To this end, one major statement should be reflected upon beforehand.

It is necessary to question the relatively unchallenged view of prehistoric textile production as a typical household occupation generally carried out by women (*cf.* Costin 2013). The aftermath of such view is that prehistoric textile production has long been considered a secondary activity of little to no importance for political economic discourses. In fact, by considering textile making just as a part of the everyday household tasks, we limit our possibility to understand the tremendous political, social, economic, and cultural importance of textile manufacturing. It is hardly deniable that a large part of the Bronze Age textile tools has been discovered in household settings, and yet in pre-urban worlds households are to a significant degree the economic engine of society. It has been widely demonstrated that craft production in general tends to be highly gendered (Costin 2013: 183), and there is no reason to believe that Bronze Age Europe was any exception in that regard. However, there is no substantial archaeological evidence to draw any reliable conclusions as to the gendered nature of the necessary steps in local textile production and trade.<sup>1</sup> Thus, to think of Bronze Age wool craft as an everyday female-related household task, and as such not affecting the political economy of the continent, is unfitting the nature of the archaeological record we are dealing with.

A recent study discussing wool production at the Italian Bronze Age Terramare site of Montale (Modena province) suggests considering the local textile production as community-based (Sabatini *et al.* 2018). Differently from, for example, metal production, which appears to have been controlled and regulated by emerging elites, thus augmenting social and economic hierarchy all over Europe (*e.g.* Earle *et al.* 2015; Kristiansen 1987; *cf.* Earle, Spriggs 2015), textile craft, at least in the Terramare setting, does not seem to be equally controllable. Although further research is necessary and new case studies should be brought to the attention of the international scholarly

community, the characteristics and distribution of the local textile-related material culture suggest that production was to a large extent a communal endeavour (see below). In other words, while in the socially more complex societies of the Eastern Mediterranean there is clear evidence of both attached and independent textile crafting,<sup>2</sup> the archaeological material from the continent does not enable to clearly single out any of the two modes of production. Specialised workshop environments or evidence of unfree labour, which are documented for instance in the Aegean and the Near East (*e.g.* Alberti *et al.* 2012; Breniquet, Michel 2014b; Sauvage, Smith 2016; Smith 2002; Stol 2016: 344–349), are largely missing in Bronze Age Europe. It is unlikely that local elites did not control decisions concerning the economic and productive spheres (compare with *e.g.* Earle *et al.* 2015; Kristiansen 2016; Rowlands, Ling 2013). However, the intensity of the textile-related labour, which must have involved large portions of local communities, possibly affected elites' control strategies (Sabatini *et al.* 2018).

## Wool economy

A long chain of manufacturing processes and economic activities is necessary to deliver the final woollen products (*e.g.* Andersson Strand 2014; Barber 1991; Costin 2013; Gleba 2008; Sofaer *et al.* 2013: 477–482; see also below). It is, therefore, argued that a working definition of wool economy is that of the whole set of practices that characterise the wool crafting *chaîne opératoire* (from sheep herding to fibre preparation, spinning, weaving, post weaving treatments, tailoring, as well as trade and consumption patterns) and the political economic design behind it. Wool economy, as it is understood here, is not exclusive. It defines a specific economic activity (production and trade of wool and woollen

<sup>1</sup> That is not to say there were no women and/or men-dominated textile-related production activities during the European Bronze Age. Instead, the intention here is to call attention to the fact that we lack sufficient evidence for either proving or denying it. Common assumptions about the gendered nature of textile work are almost exclusively based on ethnographical material and on evidence from different areas and periods (*e.g.* Barber 1991; 1994; Costin 2013; Hoffmann 1974). It is only with the very end of the Bronze Age and the beginning of the Iron Age – roughly from the 1<sup>st</sup> millennium BCE onwards – that in certain areas of the continent textile tools such as for example spindles, spindle whorls, and distaffs become regularly present in women's graves signalling also some form of a status of the deceased (*e.g.* Gleba 2008; 2013; Grömer 2013; 2016: 270–273). Likewise, it is not before the beginning of the 1<sup>st</sup> millennium BCE that women's contribution to textile production (mostly spinning and weaving) started being reflected on various ob-

jects and representations (*e.g.* Barber 1991; 1994; Gleba 2008; Grömer 2013; Turk 2005).

<sup>2</sup> Attached specialists are skilled artisans producing wealth items under the direct control of ruling elites. In the Eastern Mediterranean and Aegean regions during the Bronze Age, some textile production was likely attached and physically carried out within palace and citadel settings (Alberti *et al.* 2012; Sabatini 2016; Siennicka 2014; Tournavitou *et al.* 2015). Independent specialists produce goods on demand and may possess various skill levels. Studies on Late Bronze Age Cyprus have shown that growing textile production is accompanied by widespread presence of workshops and/or specialised activity areas in private household contexts (*e.g.* Sabatini 2018; Sauvage, Smith 2016; Smith 2002). *Cf.* Brumfiel, Earle 1987 for a theoretical discussion on the distinction between attached versus independent production.

textiles) which coexisted and intermingled with other possible ‘economies’ and productive activities.

Archaeological evidence for wool textiles and clothing from the continent suggests that by the mid-2<sup>nd</sup> millennium BCE wool was a well-known fibre in the local patterns of textile consumption (*e.g.* Bender Jørgensen, Rast-Eicher 2018; Broholm, Hald 1940; Gleba, Mannering 2012; Grömer *et al.* 2013). Raw wool during the Bronze Age was relatively precious and difficult to obtain (*e.g.* Andersson Strand 2014; Barber 1991: 20–32; Costin 2013; Gleba 2008: 72–75). To be produced in large quantities, not to mention high quality, it requires access to conspicuous numbers of woolly sheep/goats, whose management and organisation needs well-organised strategies of production and thus precise political economic choices. Hence, it is likely that in Bronze Age Europe, where the power of palace authority and pre-state societies were absent, wool production could be ‘afforded’ only when specific environmental and political pre-requisites created favourable conditions for its development (see Sabatini *et al.* 2018).

When adopting such a wide definition, one necessarily faces a problem of scale, since it is unlikely that all the phases of wool economy can be registered in one and the same Bronze Age European context. Additionally, when studied individually, each stage often reveals a further set of more specific sub-stages sometimes requiring *ad hoc* locations and tools. It is also important to remember that each of these steps could be carried out not only in separate settings, but also by different actors and in different periods of the year (*e.g.* Andersson Strand 2014; Barber 1991; 1994; Bender Jørgensen 2012a; 2012b; Breniquet, Michel 2014a; Carrer, Migliavacca *in press*; Gleba 2008). Therefore, wool economy is a complex economic phenomenon, which demands a variety of actors and places, all necessarily linked together and actively, albeit differently, contributing to it.

### Archaeological evidence in the study of European Bronze Age wool economies

In order to study European Bronze Age wool economies one can rely on a limited set of direct and indirect evidence (Tab. 1). Direct records are the archaeological evidence informing about the existence of wool either as a raw material or as a fibre or textile (faunal remains of sheep and textile fragments). Among the direct evidence contemporary written texts have been included. They represent self-sufficient sources of information addressing wool economy issues and have been used as such in the wider Mediterranean context (*e.g.* Breniquet, Michel 2014a; Michel, Veenhof 2010; Nosch 2014a), but as to the study of Bronze Age Europe they are of a solely comparative value. Indirect evidence comes from the ar-

chaeological record showing textile production in general but not unveiling the kind of fibres that were used. From a methodological point of view, it is necessary to have a combination of evidence in order to argue for the existence of a working wool economy. Without local written sources, the available evidence provides a potential, but not undisputed, proof for such economy in Bronze Age Europe.

One of the main difficulties in the study of European Bronze Age wool economy is distinguishing it from a more general textile economy. There is plenty of evidence for other fibres being used to produce textiles (*e.g.* Barber 1991: 9–35; Bazzanella *et al.* 2003; Bender Jørgensen, Rast-Eicher 2016; 2018; Bergfjord *et al.* 2012; Gleba 2008: 63–75), thus, the parallel production of different sets of products should not be ruled out. Why then distinguish between wool and other types of textile economy? The answer lies in the fact that despite some parts of the *chaîne opératoire*, such as spinning and weaving, possibly indeed being similar for all fibres, the production of the raw material, the processing technologies, and the value of the finished products varied so much between different animal and vegetable fibres that they must have necessarily fuelled different economies. Hence, it is argued that the introduction of sheepherding geared towards wool production and consequent remodelling of animal and landscape management must have represented an economic, social, and cultural innovation, likely in a similar fashion to what happened in Mesopotamia by the 3<sup>rd</sup> millennium BCE (*cf.* Bender Jørgensen, Rast-Eicher 2016; Breniquet, Michel 2014b: 2; McCorrison 1997).

### Contemporary written sources from the wider Mediterranean area

The path that leads to the current understanding of Bronze Age wool economy was beaten largely thanks to the progress in interpreting eastern Mediterranean and Near Eastern written sources from the 3<sup>rd</sup> and 2<sup>nd</sup> millennia BCE (*e.g.* Breniquet, Michel 2014a; Killen 2007; Michel, Nosch 2010; Nosch 2011; 2015; Waetzoldt 1972). Although they refer to more complex societies than those of Bronze Age Europe, they provide a rich account of the complexity of prehistoric wool economy. Their translations proved, in the first place, that wool production was a major activity moving tons of raw and manufactured material and requiring, among other things, a consistent and multifarious workforce (*e.g.* Biga 2011; Del Freo *et al.* 2010; Killen 2007; Maiocchi 2016; Nosch 2011; Peyronel 2014; Rougemont 2009; Stol 2016: 344–349). Indeed, without texts we would not have been able to grasp the revolutionary force of wool. Most of the known written sources represent a unique record as to the very existence of this specific material (*e.g.* Burke 2010; Breniquet, Michel

2014a; 2014b; Foster 2014; Killen 1964; McCorrison 1997; Michel, Nosch 2010; Nosch 2014b; 2015). There are hardly any preserved textiles from these areas, and practically all of the known fragments were made of vegetable fibres (Skals *et al.* 2015). In other words, without the texts we would have no clear indications of the role that wool played in the Bronze Age economy of these regions, including long-distance trade ventures such as those documented by the Assyrian merchants' letters found in the Anatolian site of Kaneš/Kültepe (*e.g.* Michel, Veenhof 2010; Lassen 2010).

All in all, despite the texts providing fundamental information as to the organisation of textile-making, which would have been hardly obtainable relying solely on the archaeological evidence, several questions remain open. On the Late Bronze Age Greek mainland a vivid contrast exists, for example, between the abundant written evidence for large-scale textile production and the apparent lack of storehouses for textiles or raw materials and specialised workshops or industrial areas (*e.g.* Burke 2010: 437; Tournavitou *et al.* 2015: 262). It has been proposed that such absence should be interpreted as an indication for textile production carried out extensively in different places, including households and minor settlements (*e.g.* Siennicka 2014). The widespread presence of spindle whorls, though generally in rather small concentrations and accompanied by other so-called small finds and tools within several Mycenaean citadels, has been interpreted as the evidence of attached craft being carried out in small-scale multifunctional workshops producing specific and probably exclusive products of various kinds (*e.g.* Alberti *et al.* 2012; Rahmstorf *et al.* 2015; Sabatini 2016), including textiles. How the system as a whole functioned in practice and how its specific products were manufactured remains an important question for archaeological research.

In continental Europe, where contemporary written sources are altogether lacking, the information provided by these texts offers a useful guidance and comparative material. In particular, one should emphasize the fact that Bronze Age wool fibres from the continent seem to be very similar to those that could be obtained from the so-called primitive sheep, such as the modern Soays (see below). Since the yearly wool harvest from Soay flocks appears similar or comparable to the kind of animals that are recorded, for example, in Linear B tablets (*e.g.* Del Freo *et al.* 2010), any Bronze Age wool economy on the continent would depend on relatively similar underlying conditions – at least as far as the raw material production was concerned – to those that Aegean wool economies had to face.

### Textiles and textile fragments made of wool

Woollen textile fragments from across various parts of Europe (Bender Jørgensen 1992; Bender Jørgensen, Rast-Eicher 2015; 2018; Broholm, Hald 1940; CinBa database; Gleba, Mannering 2012; Grömer *et al.* 2013; Rast-Eicher, Bender Jørgensen 2013) suggest that early in the 2<sup>nd</sup> millennium BCE wool was already known and used. With the exception of the famous collection of complete cloths found in the Danish Early Bronze Age oak-log coffins (*e.g.* Bender Jørgensen 1992; Broholm, Hald 1940), the many textiles from the Austrian Hallstatt mines (*e.g.* CinBa database; Grömer 2016; Grömer *et al.* 2013), and the cloth from the Pustopolje tumulus 16 in Bosnia-Herzegovina (Bender Jørgensen, Grömer 2013; Harding 1995; Marić Baković, Car 2014), most of the known woollen textiles from the continent consist of relatively small fragments. Despite limitations, various types of analyses and studies of such material have provided data regarding:

- The geographical distribution of wool consumption
- The techniques used to manufacture the woollen textiles
- The characteristics of the wool used to produce them
- The local or non-local character of the raw material.

Similarly to the Mediterranean (*cf.* Skals *et al.* 2015), also in Europe there is a relatively large number of preserved prehistoric textile fragments made of vegetable fibres (*e.g.* Bazzanella *et al.* 2003; Bazzanella, Mayr 2009; Gleba, Mannering 2012), which provide, at least from the perspective of this work, invaluable information about known and practiced manufacturing techniques. Without the linen textiles from the Alpine lakes, we would, for example, not be able to infer that embroidery, brocade, and patterns of concentric lozenges made in a sort of twill weave were used during the Bronze Age and were likely already known since the Neolithic (*e.g.* Barber 1991: 133–144; Bazzanella *et al.* 2003; Bazzanella, Mayr 2009). A recent study focusing on the 1<sup>st</sup> millennium BCE and on the archaeological evidence from the Italian Peninsula and the Aegean has pointed out how the numerous textile fragments from both regions allow assigning to each area a specific textile tradition (Gleba 2017). The manufacturing techniques employed to produce textiles in the Italian Peninsula clearly appear to be a part of the prehistoric tradition with roots in the European Bronze Age world until the beginning of the local orientalisering period (around the 7<sup>th</sup> century BCE). This study – although indirectly – supports the idea of European Bronze Age wool economies by suggesting that prior to the 1<sup>st</sup> millennium BCE woollen textiles had a distinct character from that of the nearby Aegean world, and thus that continental systems of demand, production, and supply likely already existed.

As mentioned, one of the relevant conclusions offered by the study of the continental textile fragments consists of the data about the characteristics of the wool used to produce them (e.g. Barber 1991: 125, 176–185; Bender Jørgensen 1992; Gleba 2008; 2012a; 2012b; Grömer *et al.* 2013; 2016; Rast-Eicher, Bender Jørgensen 2013). The Italian Peninsula has offered some of the earliest continental evidence of spun wool fibres (Bazzanella 2012; Bazzanella, Mayr, 2009: 35, 41–46, 79–78; Bender Jørgensen, Rast-Eicher 2015) found in Alpine lake dwellings and dated to the Early Bronze Age (Polada Culture, c. 2200–1650 BCE). The earliest pure woollen fabric which underwent microscopic (SEM) analyses is a fragment from the Terramare settlement of Castione dei Marchesi (Parma province), dated approximately to between 1650 and 1300 BCE (Bazzanella 2012: 209). The scientific investigations performed on its fibres suggest that the wool came from sheep resembling today's Soays (Gleba 2012a: 328–329), which moult once a year to yield 0.3–0.9 kg of wool (Robson, Ekarius 2011: 195). This figure corresponds to the wool unit in Aegean archives, expressed by the sign \*145/LANA, which seems to signify a wool sack of c. 3 kg, containing four adult sheep fleeces of c. 750 g or 10 fleeces of c. 300 g from mixed flocks (Del Frio *et al.* 2010: 340–344).<sup>3</sup> According to a neo-Sumerian source, as much as 4 kg of a fourth class wool (valued on one [royal] to five [poorest quality] scale) are necessary to obtain an average (*guz-za*) fabric of c. 3.5 x 3.5 m (e.g. Andersson Strand, Cybulska 2012: 113–118). Thus, emerging continental Bronze Age wool economies – just as in the Eastern Mediterranean (e.g. Biga 2011; Firth 2014; Halstead 1999) – would need large numbers of sheep and consequently precise political economic choices and well-organised strategies of production.

Finally, the somehow revolutionary possibility to investigate the strontium isotope signal of ancient textiles has recently opened a new avenue for understanding the European wool economy during the Bronze Age. Strontium isotope tracing methods provide information regarding the geology of the regions where a given living being did actually spend its life (Frei 2012). Wool coming from sheep contains the same strontium value as the animal that it originally covered, and thus indicates the region where it grazed. Strontium does not single out the area of origin, since many regions have similar geological characteristics and thus strontium signals, however, it would tell if the area in which the examined

material has been found is compatible or not with the obtained results. A series of analyses of the wool from the Early Bronze Age Danish oak-log coffin cloths (Frei *et al.* 2015; 2017) have brought to the attention of the international community of scholars the fact that most of the analysed material is actually made of wool coming from animals that have not lived within the present-day Denmark's territory. Considering that no convincing archaeological evidence exists for textile production in Bronze Age Scandinavia (e.g. Bergerbrant 2007: 49; Sofaer *et al.* 2013: 480), the isotopic analyses provide invaluable evidence to support the hypothesis of a continental Bronze Age wool trade at least during the 14<sup>th</sup> century BCE.

### Faunal remains and reconstructions of animal populations and kill-off patterns

Wool production is necessarily dependent on access to sheep. Therefore, the study of faunal remains and of the prehistoric animal population provides a very important set of direct evidence for wool production. Indeed, the pioneering work of Michael Ryder (e.g. 1964; 1974; 2005) on the evolution of sheep fleece has opened for the first time an avenue for better understanding of the characteristics of primitive sheep. Later studies revealed that Ryder's model provides a somewhat simplified picture of past sheep and that a new set of previously overlooked factors should be also taken into account (e.g. Gleba 2008; 2012b; Rast-Eicher, Bender Jørgensen 2013; Skals *et al.* 2018). All in all, the debate about Bronze Age wool is far from exhausted. Although it is generally accepted that the annual yield per animal was very limited, the characteristics of the wool and the possibly existing sheep breeds remain a matter of debate. Ongoing attempts to study the DNA of ancient sheep (Brandt, Allentoft in press; Brandt *et al.* 2011) and recent investigations of ancient protein residues (Di Gianvincenzo *et al.* in press) will hopefully soon provide new datasets to work with.

As per the scope of this paper, the very amount of sheep/goat remains appears to be of greatest importance for assessing local engagements in wool economy. Since, as repeatedly mentioned, large herds are necessary to produce wool and woollen textiles, sites with a high preponderance of sheep/goats over other taxa become likely candidates for such production. It has been pointed out how sheepherding geared towards wool production would ideally require specific kill-off patterns since most wool is obtained from, for example, wethers, followed by

<sup>3</sup> One might, however, consider that these figures are probably not universally valid and some adjustments are necessary from case to case. Although Eurasian Bronze Age sheep in general seem to produce limited amounts of wool, it has been calcu-

lated that Mesopotamian sheep already at the very end of the 3<sup>rd</sup> millennium BCE provided a slightly higher wool yield (between 0.7 and 1.12 kg of wool per year) than their later counterparts in the Aegean (Andersson Strand 2014: 44).

adult ewes (*e.g.* Barber 1991: 25–28; Halstead, Isaakidou 2011; Payne 1973). The presence of a large number of wethers would therefore suggest wool production more than anything else. A large amount of young animals would instead indicate that herds were mostly kept for milk and meat consumption. The precisely recorded information from the Linear B archive of Knossos (Del Frio *et al.* 2010) shows that the palace was well aware of these factors and that specialised wool flocks existed; however, the very same sources show that even in the very well-organised case of Knossos, and despite its large demand for wool, one could hardly escape a mixed economy and thus flocks with animals of different ages, including the young, were also taken care of.

The study of the archaeozoological remains from the Bronze Age site of Százhalombatta-Földvár (Pest province, Hungary) revealed an enlightening pattern suggesting that a clear shift in the political economy of the site occurred at the onset of the 2<sup>nd</sup> millennium BCE. From the 3<sup>rd</sup> millennium BCE, the prevalence of cattle became rapidly replaced by sheep/goat herding accompanied by changes in sheep kill-off patterns, which suggests that raising sheep became geared towards wool production (*e.g.* Vretemark, 2010: 163–166; see also Bender Jørgensen, Rast-Eicher 2015). Interestingly enough, on the very Százhalombatta-Földvár tell a conspicuous number of Middle Bronze Age textile tools were also found (Bergerbrant 2018). It is therefore likely that Százhalombatta-Földvár was one of those European communities that took advantage of local favourable conditions to engage in one of the earliest wool economies of the continent.

Another example of a community likely engaging in wool economy is represented by the Bronze Age Terramare site of Montale (Modena province) in northern Italy (*e.g.* Cardarelli 2009).<sup>4</sup> The site has been recently subjected to a series of investigations aiming at understanding the characteristics of the local textile production (*e.g.* Sabatini in press; Sabatini *et al.* 2018). During more than a hundred-years-long chain of excavations and collecting of archaeological material at the site, an outstanding number of textile tools have been gathered (see below). Archaeozoological studies of the animal remains from the site, although published only preliminarily, show that at any given time sheep/goats not only represented the local largest taxa (with a long-term average of *c.* 50% of all the animal remains), but also suggested that the number of sheep/goats increased over time and during the first part of the Italian Recent Bronze Age (*c.* 1325/1300–1225/1200 BCE), which is the

site's final phase, constituted up to over 60% of the local animal population (De Grossi Mazzorin 2013; De Grossi Mazzorin, Ruggini 2009).

### Textile tools

Costin (1991: 1) considers craft specialisation ideal for archaeological investigation because of the rich evidence that tools leave in the archaeological record. And indeed, tools for production of textiles, such as spindle whorls and loom weights, which were normally made of non-perishable material such as clay or stone, were widespread on the continent since before the Bronze Age (*e.g.* Gleba, Mannering 2012). A crucial issue for the present work is that while they unmistakably document textile production, they do not, however, account for wool economy, unless it is possible to correlate their presence with other significant evidence. They are, therefore, to be considered essential but indirect evidence. In the absence of any other record (such as textile fragments or faunal remains of sheep/goats), textile tools alone cannot be used to presume wool economy.

On the other hand, textile tools can provide very good evidence for understanding the scale of local textile production (*e.g.* Andersson Strand, Nosch 2015). A careful documentation of the textile tools excavated at the mentioned site of Montale in northern Italy demonstrates that specialised textile production can be archaeologically detected far from the known Eastern Mediterranean centres of the time (Sabatini *et al.* 2018). Over 4500 spindle whorls were recovered at the site, suggesting more than anything else that textile production was close to an industrial scale and that a large portion of the local population (estimated to a maximum of *c.* 125–130 individuals per generation, *cf.* Cardarelli 2015: 167) must have been involved in textile production. The information obtained by the analysis of craft specialisation at the site, when combined with the mentioned analysis of the faunal remains (De Grossi Mazzorin 2013; De Grossi Mazzorin, Ruggini 2009), leaves little doubt regarding the possibility that the local population was engaged in wool economy. Studies on the characteristics of the settlement patterns in what could be considered Montale territory and neighbouring areas suggest that community specialisation may have taken place (*cf.* Costin 1991: 8) with a division of labour between the settlement on the plain (specialised in textile production) and those in the mountainous area to the south of the plain (involved, among other things, in seasonal shepherding) (*cf.* Cardarelli 2006; Cavazzuti, Putzuolo

<sup>4</sup> The Bronze Age chronology for mainland Italy can be summarised as follows (see also Cardarelli 2015): Early Bronze Age (*c.* 2200–1700/1650 BCE); Middle Bronze Age (*c.* 1700/1650–

1325/1300 BCE); Recent Bronze Age (*c.* 1325/1300–1150 BCE); and Final Bronze Age (*c.* 1150–950/925 BCE).

2015). Montale is unique due to the enormous amount of spindle whorls found at the site, but it is likely not an isolated case. Across the Po plain and the Terramare area in northern Italy, a number of site-specific publications suggest that textile production in general was practiced widely, although with different intensity at various sites (Bernabò Brea *et al.* 2003; Bianchi 2004; Desantis 2011; Lincetto 2006; Sabatini *in press*).<sup>5</sup> It is also clear that generally sheep/goat is a very common taxa all over the plain, thus engagement in wool economy may have taken place in different forms. One hypothesis could be that there was a production system (*cf.* Brumfiel, Earle 1987) with independent communities able to exploit local environmental, technological, and organisational advantages to meet a wider demand. Alternatively, one could think of a network system in which production was somehow coordinated between settlements, some of which were specialised, like Montale. Such questions necessarily represent an important avenue for future studies.

## Discussion

The very aim of the present paper is to discuss how and on what basis wool economy can be investigated in Bronze Age Europe. Wool economy has been successfully used to define the systems of manufacture, exchange, and consumption that characterise the Near Eastern and Aegean regions during the 3<sup>rd</sup> and 2<sup>nd</sup> millennia BCE (*e.g.* Breniquet, Michel 2014a; Nosch 2014a; 2014b). In this period, the characteristics of Bronze Age societies in continental and northern Europe are not comparable in terms of socio-cultural and political complexity to those from the Mediterranean area; however, during the 2<sup>nd</sup> millennia BCE they came to know and appreciate wool and woollen products. Studies on the characteristics of local weave and thread preparation suggest that textiles from Bronze Age Europe have a distinct ‘continental’ character, which lasted until the Early Iron Age (Gleba 2017) and thus likely did not depend on supplies from the Mediterranean world.

Considering that Bronze Age sheep in Europe were apparently rather similar – at least as far as wool yield is concerned – to those that are recorded in, mostly Aegean, written sources, wool production required access to large herds. The presence of large numbers of animals, in turn, directly raises issues of landscape management and maybe seasonal exploitation of different territories. As there is no evidence for dominant elite groups controlling attached

textile productions, it seems that continental wool economies were managed at the community level (Sabatini *et al.* 2018). Moreover, sheepherding and raw wool production are just the initial steps of any wool economy. Once wool is collected, textile production is a time-consuming, year-round activity which engaged a considerable number of workers, for example in the documented case of the Near East and the Mediterranean economies. There is no evident archaeological record suggesting large scale unfree labour in Bronze Age Europe, therefore it is likely that craft specialisations must have followed precise political economic choices at the community level. The presence of wool textiles and wool fragments in several parts of the continent, including Scandinavia where strontium tracing analyses unveiled that wool was largely imported (*e.g.* Frei *et al.* 2015; 2017), strongly supports a twofold hypothesis. On the one hand, the evidence proves the existence of continental wool trade (see *e.g.* Kristiansen 2016; Kristiansen, Stig Sørensen *in press*), *i.e.* one of the last necessary steps for a working wool economy. On the other hand, it also suggests that there must have been centres of production able to provide woollen textiles to areas where wool was consumed but not manufactured, at least not on a large scale (see also Bergerbrant *in press*; Sabatini, Melheim 2017).

From a methodological point of view, the study of any wool economy would benefit from the possibility to single out centres of production. As Costin (1991: 1) points out, tools are the primary source of information for the study of craft specialisation, but as far as Bronze Age wool economy is concerned, we lack specialised tools. Paradoxically, the very same primary evidence for textile production is alone not sufficient to suggest engagement in wool economy! Only when it is combined with another set of direct data (see Tab. 1) can we attempt envisioning such economy. Keeping an eye on the informative but only comparative sources from the wider Mediterranean area, the coexistence of archaeological records of textile tools and archaeozoological data suggesting large numbers of sheep provides the most successful combination of evidence to suggest local engagements in wool economy. The presence of woollen textile fragments is very important but more problematic for discourses on the political economy of the continent. Nonetheless, thanks to recent advances in strontium isotope tracing analyses, such fragments have become crucial for unveiling the existence of wool and woollen textile trade.

<sup>5</sup> As far as the textile production is concerned, beside Montale, we have accurate information from modern excavations at the sites of Poviglio (Bernabò Brea *et al.* 2003; Bianchi 2004; Lincetto 2006: 114–127, 193–218), Beneceto (Bernabò Brea *et*

*al.* 2003; Lincetto 2006: 138–156), and Fraore (Lincetto 2006: 180–186), in the Parma province from Anzola (Desantis 2011), and Borgo Panigale (Lincetto 2006: 219–225) in the Bologna province.

Tab. 1. Available archaeological evidence for studies on the European Bronze Age wool economies.

Evidence	Type of evidence	Information provided	Observations and problems
Written sources	(Direct)/ Comparative	<ul style="list-style-type: none"> <li>evidence for existence of wool economy</li> <li>information on intensity/organisation of labour</li> <li>data on production <i>chaîne opératoires</i></li> <li>'quantities'/figures related to production and trade</li> </ul>	Written sources provide direct evidence for wool economy in the contexts where they have been found. Beyond the coasts of the Mediterranean they have but a comparative value.
Textiles and textile fragments made of wool	Direct	<ul style="list-style-type: none"> <li>data on the use of woollen textiles</li> <li>characteristics of the wool</li> <li>characteristics of the weave and thread preparation techniques – potentially characteristics of a local fashion</li> <li>the potential evidence for trade (strontium isotope analyses)</li> </ul>	Textile remains potentially but not necessarily account for production in the contexts in which they have been found, since they may have been produced somewhere else.
Faunal remains and reconstructions of sheep/goat populations and kill-off patterns	Direct	<ul style="list-style-type: none"> <li>potential evidence for existence of raw material (wool) production</li> </ul>	High percentages of sheep/goat bones hint at wool production, although not necessarily (milk, meat, and leather might be the actual production) or exclusively.
Textile tools	Indirect	<ul style="list-style-type: none"> <li>evidence for existence of textile craft in general</li> </ul>	Archaeologically common Bronze Age tools such as spindle whorls and loom weights do not indicate which kind of fibres were manufactured.

### Concluding remarks

Continental wool production and trade during the Bronze Age likely reached complexity and extension that necessitate major scientific attention not only regarding the phenomenon *per se* but also its prominent historical role. Wool economy, as discussed in this paper, could represent a useful framework for further studies on the subject. There is no space to expand this discussion much longer, but it should be finally emphasised that the hypothesis of wool economy as a result of precise political choices largely involving Bronze Age communities gives the possibility to link it back to the gender issue touched upon at the beginning of this paper. It has been suggested that for a better understanding of Bronze Age wool production it would be necessary to question general assumptions on the gendered nature of the textile-related work during prehistory. Differently from what appears common in later periods, the available archaeological evidence suggests that during the Bronze Age wool production likely required community specialisation and engaged significant parts of local populations.

Gendered tasks presumably existed during the Bronze Age but become variously manifested in the archaeological record only at a later stage, roughly by the beginning of the 1<sup>st</sup> millennium BCE. It is not possible to address the issue here, however, the evidence would suggest that substantial social transformations occurred at the time and appear to chronologically coincide with the possible introduction of woollier sheep (*e.g.* Gleba 2012a: 333) and thus with considerable transformations in raw material production systems.

To conclude, the production of woollen textiles requires a complex organisation of labour and resource management. Thus, European Bronze Age societies would probably not engage in such complex *chaîne opératoires* if they were not aware of the value of this production and the benefit that its outcome may have had, for instance as an export commodity (*e.g.* Sabatini *et al.* 2018). The introduction of wool production and trade must have therefore been a result of precise political economic choices. Adopting the wool economy perspective for the study of the relevant material culture from continental Europe shall help posing insightful questions and



enhance understanding of the prominent historical role of this craft specialisation for the development of Bronze Age societies.

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