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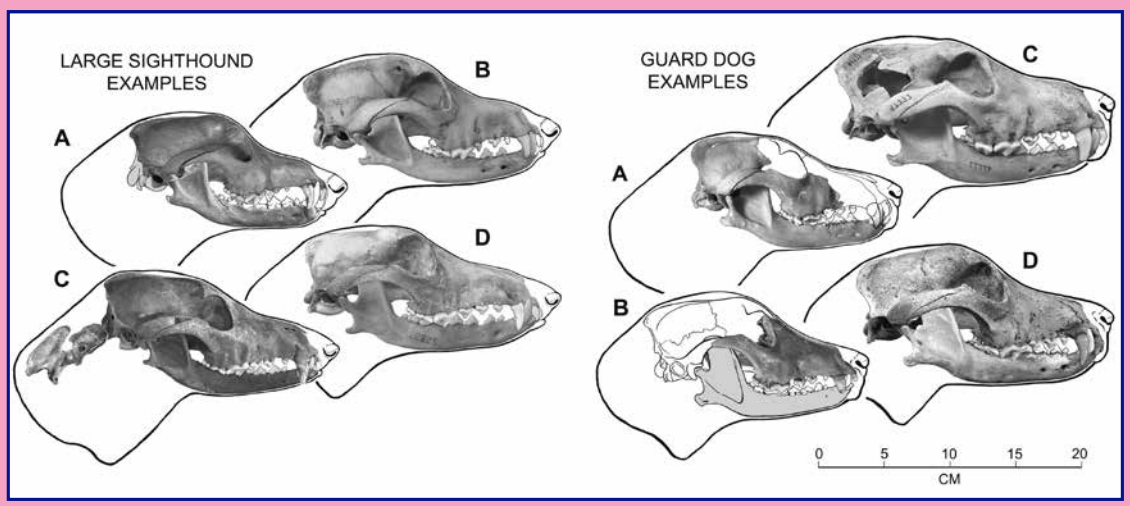

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Índice/Contents

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The faunal assemblage from the manufacturing district at Spolverino: from the Roman Imperial period to Late Antiquity

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ABSTRACT: This paper presents a zooarchaeological analysis from the site of Spolverino (southern Tuscany, Italy). Archaeological excavations have uncovered a complex stratigraphy dated from the Roman Imperial period to Late Antiquity (late 1st- early 6th centuries AD). The industrial function of the site in Imperial times is partially reflected in the nature of the faunal assemblage. In Late Antiquity, Spolverino lost its original manufacturing functions, as many of the workshops were abandoned; our evidence, however, suggests that some livestock was kept, probably managed by a restricted group of people still living in that area. Some hunting was practiced throughout the occupation but it increased in the later periods. Remarkable, in Late Antiquity, is the occurrence of the fallow deer, an introduced species, rare in Roman contexts.

KEYWORDS: FAUNA, LIVESTOCK, HUNTING, ROMAN TIMES, LATE ANTIQUITY, ITALY

RESUMEN: Este trabajo presenta un análisis zooarqueológico del yacimiento de Spolverino (Toscana meridional, Italia). Las excavaciones arqueológicas evidenciaron una compleja estratigrafía que discurría desde el periodo Imperial Romano a la Antigüedad Tardía (finales del siglo I hasta principios del VI AD). El carácter industrial del asentamiento en época imperial queda parcialmente reflejado en la naturaleza de la asociación faunística. Durante la Antigüedad Tardía Spolverino perdió su actividad manufacturera original al ser abandonados muchos de sus talleres; nuestros resultados, sin embargo, revelan el mantenimiento de algún ganado, posiblemente criado por parte de un grupo restringido de personas que permaneció en el lugar. A lo largo de la ocupación siempre existieron evidencias de actividad cinegética, las cuales aumentan en las fases finales. Cabe destacar, en la fase de la Antigüedad Tardía, la presencia de gamo, una especie introducida, que suele ser muy infrecuente en contextos romanos.

PALABRAS CLAVE: FAUNA, GANADERÍA, CAZA, ÉPOCA ROMANA, ANTIGÜEDAD TARDÍA, ITALIA

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THE SITE

The archaeological site of Spolverino is located by a meander of the Ombrone river, in the Maremma Regional Park (southern Tuscany, central Italy) (Figure 1). The site has been known since the 18th century AD when historical maps included a road ending at Spolverino, showing a cluster of Roman ruins (Sebastiani, 2014 a, b). The area in which the site is located has traditionally been referred to as the 'Ponte del Diavolo' (the Devil's Bridge) (Mazzolai, 1968; Citter, 1995; Stea & Tenerini, 1996; Sebastiani *et al*., 2012, 2013). The initial interpretation of the site was as a crossing point along the river Ombrone, located on the *Via Aurelia vetus*/*Aemilia Scauri*. Unquestionably, the position of the site was strategic; this has also been confirmed by recent geological studies demonstrating the proximity of the sea to the site in Roman times (Citter, 2015).

From 2010 to 2013, excavations carried out at the site by the Alberese Archaeological Project uncovered the remains of a multi-purpose complex, which included at least nine rooms (Figure 2). Many of these were dedicated to the recycling and processing of metal and glass objects; this contrasts with other known regional economies in the area, which relied on the commerce of agrarian products (Sebastiani & Derrick, 2020). Most likely, the site served as a cabotage port for the Roman city of Rusellae (Sebastiani, 2014b), a function that was shared with the nearby sites of Scoglietto (Sebastiani *et al*., 2015) and Umbro flumen (Chirico, 2020). The excavation uncovered a wide range of industrial features, which were attributed to five periods dated from the 1st century AD to modern times, as summarised in Table 1.

MATERIALS AND METHODS

The faunal assemblage from Spolverino produced 526 recorded specimens. These belong to a wide chronology, ranging from the late 1st to the early 6th century AD. The subdivision adopted for this study follows the main functional and structural changes described in the previous section. Data from different periods were merged to increase

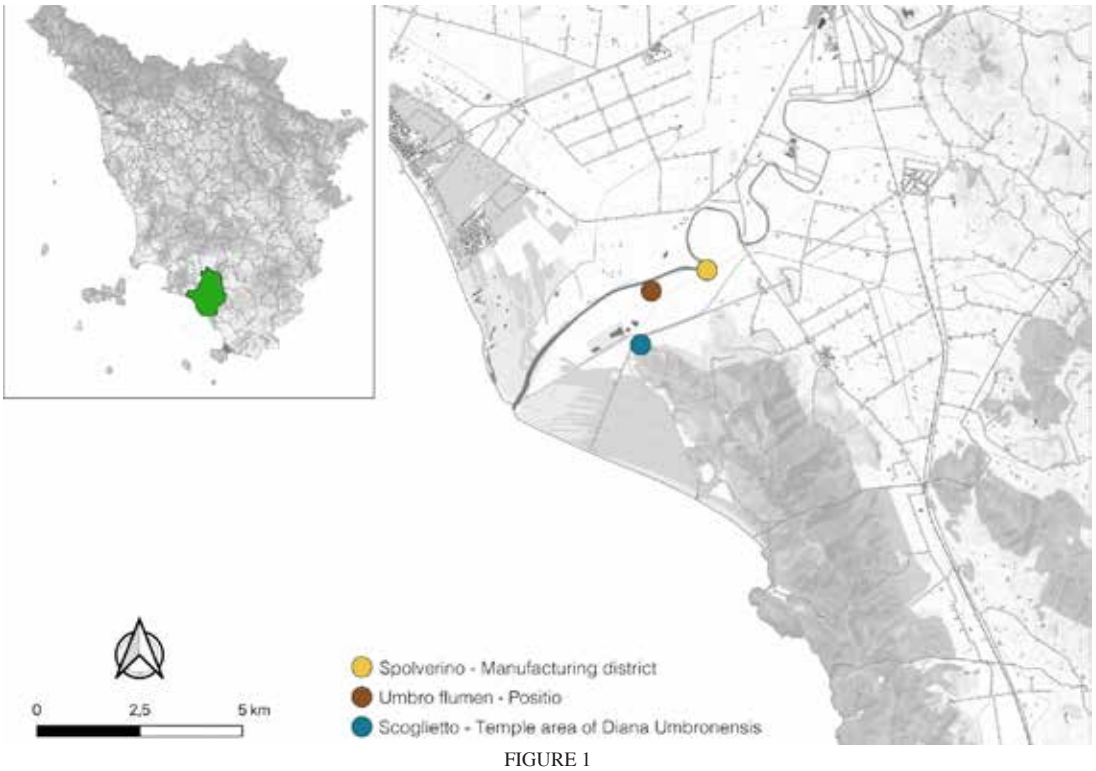

FIGURE 1

Map showing the location of the manufacturing district at Spolverino (Alberese), and the other sites mentioned in the text.

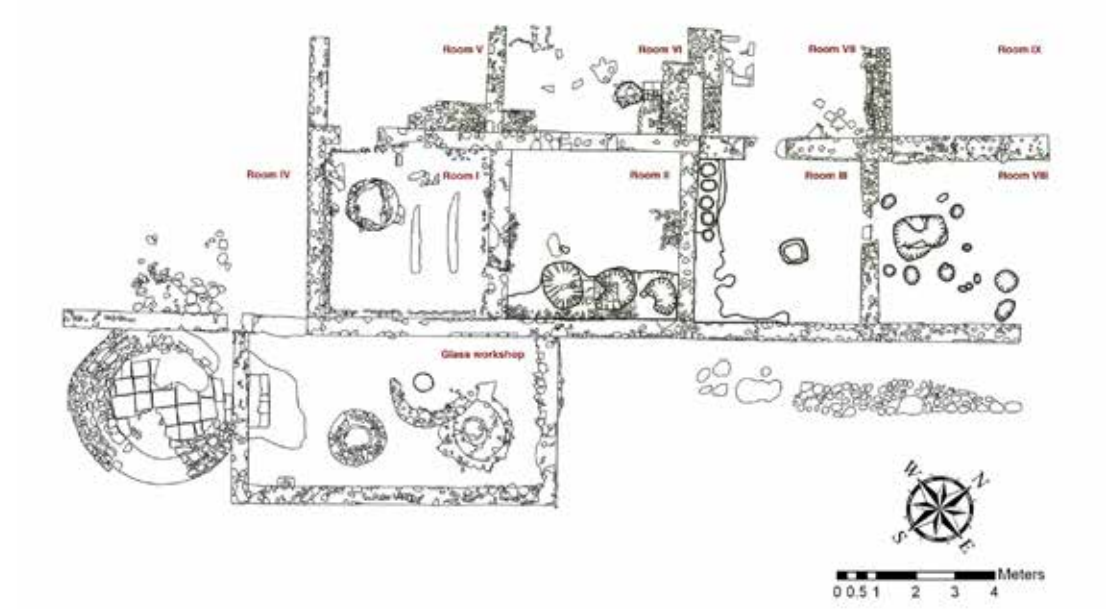

FIGURE 2
Multi-phased plan of the manufacturing district at Spolverino.

Periods	Chronology	Archaeological features
Period 1	Domitian Era - second half of the 2nd c. AD	construction of the complex glass workshop in Room I storage facilities in Room II dumping levels in Room VII
Period 2	end of the 2nd c. AD - 3rd c. AD	glass workshop built outside the complex bone workshop in Room I iron and lead Workshop in Room II communal kitchen in Room III lead workshop in Room VII
Period 3 Phase A	end of the 3rd c. AD - first half of the 4th c. AD	roasting channels in Room I metal workshop in Room II communal kitchen in Room III lead workshop in Room VII glass workshop outside the complex
Period 3 Phase B	second half of the 4th c. AD - mid-5th c. AD	metal workshop in Rooms I and II communal kitchen in Room III lead workshop in Room VII storage facilities in Room VIII glass workshop outside the complex
Period 4 Phase A	second half to the end of the 5th c. AD	'humble' tile floors in Rooms III, VII and VIII limestone kiln in Room VI
Period 4 Phase B	beginning of the 6th c. AD	necropolis
Period 5	6th c. AD - modern times	agricultural fields and flood deposits from the Ombrone river

TABLE 1
The chronology of Spolverino followed by a brief description of the main archaeological features characterising each of the five periods.

sample size, but also to focus on three main lines of investigation. Firstly, we wished to analyse the nature of animal exploitation at a Roman industrial site. Secondly, we wanted to find out the extent to which the animal bones were by-products of the bone working industry. Finally, we were interested in potential changes in animal husbandry in Late Antiquity (Table 2).

Chronology (see table 1)	Chronological reorganisation in this study	
Periods 1	Domitian Era – Late 2nd c. AD	Period 1: Imperial period
Period 2 - Period 3A	Early 3rd – late 3rd c. AD	Period 2: Imperial period
Period 3A - Period 5	Mid 4th – early 6th c. AD	Period 31: Late Antique period

TABLE 2
The reorganisation of chronological periods adopted for zooarchaeological analyses (see Table 1 for details of each period).

The recording of the animal remains followed a diagnostic zone approach (Watson, 1979). This relied on the protocol created by Albarella & Davis (1994), with the exception of the exclusion of loose teeth from quantifications. Each specimen was recorded and counted when more than half of a specific diagnostic zone was present. Taxonomic identification was aided by comparison with the reference collection held at the Department of Archaeology of the University of Sheffield (UK). The animal bone atlases by Schmid (1972) and Barone (1976) were also used for identification. Cohen & Serjeantson's (1996) work further helped the identification of bird remains.

The main reference used to separate between sheep/goat and roe deer (*Capreolus capreolus*) was Helmer & Rocheteau (1994), while Prummel (1988) was consulted when needed to distinguish between cattle (*Bos taurus*) and red deer (*Cervus elaphus*) remains. The distinction of different cervids (red deer and fallow deer) was based on the criteria suggested by Di Stefano (1995), Lister (1996) and through direct comparison with the Sheffield zooarchaeology reference collection.

The relative proportion of each taxon was quantified through the analysis of the number of identified specimens (NISP).

Due to a dearth of mandibles, the age profile of the main domestic species relied on the epiphyseal fusion of postcranial bones. The fusion data were grouped into three stages according to Silver (1969). Fusion percentages were only calculated when the number of available fusion data was ≥ 5 in each age stage (early, middle and late).

The sex of pigs was determined based on the size and morphology of canines (upper and lower). Antlers were used as a criterion to establish the occurrence of male cervids. The presence/absence of the spur on domestic fowl tarsometatarsus was recorded to distinguish hens from cockerels (Sadler, 1990), though we are aware that exceptions may occur.

Taphonomic processes were systematically recorded. The surface preservation of the material was recorded by using five different stages: 'excellent', 'good', 'medium', 'bad' and 'awful'. Though these stages are subjective, they still provide a useful rough approximation of the preservation condition of the bone.

The majority of animal remains from the site of Spolverino was hand-collected; only some of the contexts associated with the bone workshop were partially sieved. It is, therefore, reasonable to assume that the faunal sample is affected by recovery bias, with smaller specimens more likely to have been overlooked during the excavation. To investigate the degree of recovery bias, the proportions of loose teeth and jaws of cattle, caprines, and pigs were calculated. Teeth and jaws were chosen because of the dearth of postcranial elements of different sizes that are adjacent in their anatomical position (e.g. tibiae and astragali). Teeth are much more mineralised than bones and, therefore, more durable (Weigelt, 1989); this and the higher chance of survival of mandibles in comparison to postcranial bones made them well-suited for this type of analysis.Gnawing, burning and butchery evidence was regularly recorded; butchery marks were classified as cut marks, chop marks, and/or saw marks.

Measurements on bones were taken after Driesch (1976), Payne & Bull (1988), Davis (1992), and Albarella & Payne (2005), but they only provided small sample sizes.

RESULTS

Surface preservation

Most animal bones were characterised by a good-to-medium level of surface preservation. In many instances, however, the surface was encrusted with minerals, while several fragments were heavily weathered and presented a 'rounded shape' of their edges. This may be related to the proximity of the site to the river Ombrone and the occasional flooding of its shores. Furthermore, shallow cracks caused by rooting were observed on some fragments. In a small number of cases the poor state of preservation compromised the anatomical and taxonomic identification of the faunal remains.

Recovery bias

This analysis assumed that, since isolated teeth belonging to smaller species, such as caprines and pigs, are less likely to be collected, their under-representation compared to the larger cattle teeth would be indicative of a recovery bias. At the same time, however, the differential fragmentation of jaws from different species can influence the results of such analyses and must be taken into account in the interpretation.

As Figure 3 indicates, in proportion to jaws, cattle loose teeth are better represented than those of pigs and, especially, caprines. This is the expected consequence of a recovery bias, though the difference between the three taxa is not marked. Therefore, the results suggest that recovery bias played a role in the formation of the Spolverino animal bone assemblage, but this was fairly marginal, possibly because some sieving contributed to the collection of the material. It is also possible that a greater fragmentation of cattle mandibles may have contributed to the pattern.

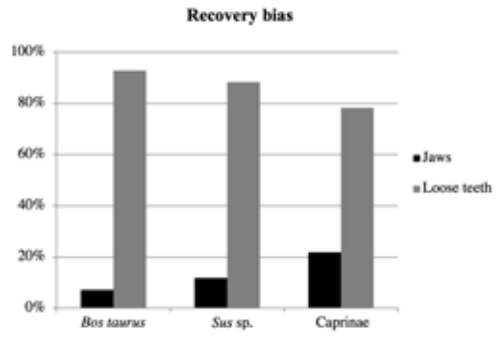

FIGURE 3

Proportion of cattle, pig, and caprines loose teeth and jaws recovered in all periods at Spolverino (n:188).

Species frequency

The faunal assemblage from Spolverino is dominated by pigs (*Sus domesticus*) in all periods (Table 3). The biometrical data were insufficient to assess the possible occurrence of wild boar. Although the presence of the latter cannot, therefore, be ruled out, the abundance of unfused bones suggests that most specimens are more likely to originate from domestic animals. By Late Antiquity, pig frequency drops substantially, although it remains the most common animal (Figure 4).

Taxa	Period 1	Period 2	Period 3
Bos taurus	1	5	13
Caprinae	2	10	19
Sus sp.	13	36	30
Equidae	2	1	14
Canis/Vulpes	-	4	8
Felis sp.	-	-	1
Capreolus capreolus	-	-	2
Cervus elaphus	1	10	18
Dama dama	-	-	1
Lagomorpha	-	2	1
Gallus/Phasianus	7	7	25
Corvus sp.	-	-	3
Fulica atra	-	-	+
Perdix perdix	-	-	2
Streptopelia turtur	-	-	+
Testudo sp.	-	2	5
Rattus/Arvicola	-	2	3
Total	**26**	**80**	**145**

TABLE 3

List of all the taxa recovered at Spolverino in each period. In case a taxon is only present with non-countable fragment(s), this is indicated with a +.

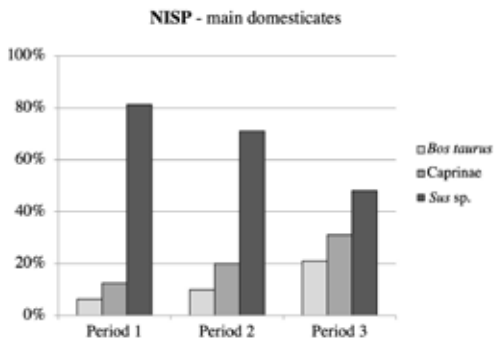

FIGURE 4

Frequencies based on the Number of Identified Specimens (NISP) for the main domesticates, divided by period. Sample sizes: Period 1: 16; Period 2: 51; Period 3: 62.

Cattle (*Bos taurus*) and caprines (*Ovis aries*/*Capra hircus*; combined) represent between 20% and 50% of the remains of the main domestic animals, although they both show a tendency towards a slight increase with time (mirroring the decline in pig frequencies) (Table 3 and Figure 4). Both sheep and goat have been identified but in insufficient numbers to establish their relative proportions.

Equids (Equidae) are uncommon, their incidence being higher in Late Antiquity. The equid bones are all potentially consistent with horses, though the presence of donkeys and hybrids (i.e. mules and hinnies) cannot be excluded.

A few remains of canids (*Canis*/*Vulpes*) were recorded in the two Imperial periods, while felids are only represented by one remain in Late Antiquity.

Wild animals are also present. Red deer (*Cervus elaphus*) is the most common wild species. Fragments belonging to roe deer (*Capreolus capreolus,* distal humerus) and fallow deer (*Dama dama*, astragalus) attest to the presence of these two species at Spolverino in Late Antiquity.

Wild birds (i.e. Corvids - *Corvus* sp., coot - *Fulica atra,* grey partridge - *Perdix perdix,* turtle dove - *Streptopelia turtur*), chelonians, and small rodents are also present. Due to the high level of fragmentation of the carapax and plastron, it has not been possible to establish whether the chelonian remains belonged to freshwater turtles (*Emys* sp.) or terrestrial tortoises (*Testudo* sp).

In addition, lagomorphs are present in Period 2 and Period 3, although it was not possible to distinguish between hares and rabbits.

Domestic fowl (*Gallus gallus*) is especially abundant in Late Antiquity, where it represents 17% of the overall sample. Domestic fowl and pheasant (*Phasianus colchicus*) bones can only in a few cases be easily separated but the former is far more likely and the remains are therefore discussed in the rest of this paper as belonging to that species, though the presence of the odd pheasant bone cannot be ruled out (Table 3).

Ageing and sexing

Only the sample of pig remains was large enough for ageing analyses (these are based on the epiphyseal fusion of post-cranial elements), though red deer will also be briefly considered.

Some changes in pig husbandry can be observed through time (Figure 5). In Period 1, almost 80% of the pigs were culled before 2-3 years of age (middle fusing), probably once they had reached their optimum weight. However, caution is needed due to the small sample size.

In Period 2, there is evidence of common consumption of young animals (ca. 50%). Besides, the presence of fused bones in the late fusing stage (ca. 20%) indicates that some pigs survived into adulthood (≥ 3-4 years); these probably represent sows and boars that were kept for reproduction. The pattern is similar in Late Antiquity (Period 3).

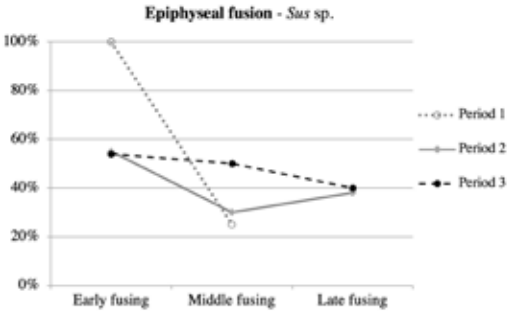

FIGURE 5

Incidence of pig fused elements in the three fusing stages (Silver 1969) at Spolverino. Number of fusion data used in each stage: Period 1(sample size: n: 18; early fusing: 5; middle fusing: 13); Period 2 (sample size: n: 50; early fusing:10; middle fusing: 6; late fusing: 6); Period 3 (sample size: n: 38; early fusing: 8; middle fusing; 6; late fusing: 5).

One perinatal mandible was present in each period. Such remains probably represent stillbirths and would therefore be indicative of on-site breeding.

Red deer bones all seem to belong to adult animals. Perhaps the larger (mature) animals were targeted, as they provided more meat and may have also been more impressive, therefore giving more glory to the hunt. Additionally, the males, in some seasons at least, would have provided valuable antlers to be used as working material.

Pig canines are especially common in Period 3, mostly from males (Table 4). The uneven representation of the two sexes may be a consequence of recovery bias, as the majority of canines were loose and male canines are larger and more easily spotted during excavation. However, though the small sample size invites caution, male jaws are also predominant. Therefore, castrated pig males may have been preferred in an extensively managed pig herd. Canines from castrated pigs do not differ greatly in shape and size from those of boars. At the same time, large numbers of adult entire males (boars) are unlikely as these are aggressive and unrequired as one male can fertilise many females.

Out of seven domestic fowl tarsometatarsi recorded in Period 3, only one was spurred, indicating the presence of at least one male (females

occasionally grow spurs, but these are generally underdeveloped), and therefore suggesting the presence of a breeding flock on site.

***Sus* sp.**	**Period 1**		**Period 2**		**Period 3**	
	Sows	Boars	Sows	Boars	Sows	Boars
Canines in jaws	1	-	1	-	2	6
Loose canines	-	-	-	1	5	12
Total	**1**	**-**	**1**	**1**	**7**	**18**

TABLE 4
Male and female pigs based on mandibular and maxillary canines present in each period.

Body part distribution and butchery evidence

The body part distribution of the three main domesticates is mainly affected by differential recovery, as demonstrated by the dearth of small elements, such as phalanges, carpals, and tarsals. Cranial remains – especially pig teeth – are the most abundant body parts. Since heads are the typical elements left off-site during primary butchery, their common occurrence rather suggests the presence of complete carcasses. Fore and hind limbs are approximately equally represented.

Red deer are mostly represented by antler fragments (including shed antlers, but not included in Table 3), with a few postcranial bones present in Periods 2 and 3. Unfortunately, detailed reconstructions of antler use were prevented by the high degree of fragmentation.

Butchery marks were present on less than 10% of the domestic mammal bones (countable remains). The only exception is represented by the pig bones from Period 2, when ca. 70% of the remains present butchery marks (mainly cuts) (Figure 6). Cut marks were mainly located at the articular ends of long bones. Chop marks were mainly distributed along the shafts of long bones, especially humeri, and on vertebral bodies; some of this evidence could refer to marrow extraction, while knives were mainly used for disarticulation and the division of the carcass in smaller units.

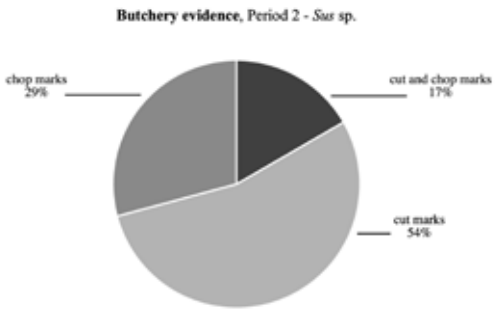

FIGURE 6
Butchered post-cranial bones of suids in Period 2; proportions of cut marks, chop marks, and cut and chop marks (total number of butchered bones n:24).

Saw marks were observed on cervid antlers from the Imperial Periods, attesting to the use of this raw material for the manufacture of tools and ornaments (Figures 7 and 8).

FIGURE 7
Antlers fragments from Period 2 with saw marks. Photo credit: authors.

FIGURE 8

Worked antler from Period 2 which may represent a tool. Photo credit: authors.

DISCUSSION

The settlement of Spolverino was built from scratch in the second half of the 1st c. AD and a glass workshop was installed in Room I, from where most of the animal remains were recovered, although belonging to different temporal phases. Only a few fragments originate from the communal kitchens (Room III), suggesting the existence of an organised waste-disposal system.

In this earliest period of existence of the site, a specialised animal economy based on pig husbandry is attested. This is consistent with the well-known pig predominance in Imperial Roman Italy (MacKinnon, 2001; De Grossi Mazzorin, 2004), which is, however, mainly reported for urban sites. It is therefore interesting to see it replicated at a predominantly industrial site, such as Spolverino. The pig was a well-suited animal to fulfil the dietary needs of emerging communities, as it is fast-growing, fast-reproducing, and relatively easy to manage. Most of the pigs from Spolverino were culled when they had reached their optimum weight, to minimise management costs and maximise yield. The presence of a perinatal individual suggests that some pig breeding occurred on site.

Despite the small sample size, it seems clear that cattle and caprines were less common than pigs in Period 1, thus playing a less prominent role in the life, economy and diet of the local inhabitants.

The equids, present in small numbers, were probably mainly used as transport and pack animals (White, 1970; De Grossi Mazzorin *et al*., 1998); indeed, most of them were adult or elderly individuals, although no pathological conditions were detected. In the 3rd century AD, the first glass workshop in Room I fell into disuse and a new surface was laid out. This presented a large amount of bone chips scattered all around the room; moreover, the recovery of antlers, partially worked bones with saw-marks, and a substantial amount of finished bone objects (hinges, bone hair-pins, die, everyday life objects) confirms the hypothesis that a bone workshop was present here, taking advantage of a local supply of domestic and wild animals – indeed, the most important change in this period concerns the higher proportion of wild game, mostly represented by red deer. Although the red deer was hunted for its meat, its antlers must have been valuable working material. These worked bone and antler remains, currently under analysis by V. Pica, contribute to our understanding of the role that antler and bone working had in manufacturing activities in Imperial central Italy (De Grossi Mazzorin & Minniti, 2012). The presence of the same typology of bone objects at the Domus of the Mosaics in *Rusellae* suggests the existence of a local market for such products (Michelucci, 1985; Sebastiani *et al*., 2015).

In this same period, some changes in animal husbandry can also be observed. Like in the previous period, pork was the most consumed meat, though a slight increase in the proportion of cattle and caprines suggests an enhanced use of beef and mutton. The presence of a perinatal mandible suggests that some pig breeding was still carried out on site. Unlike the first centuries of the Imperial period, very young pigs were by now consumed.

Dogs are attested in this later Imperial period and were probably used for hunting, protection, driving the herds, and possibly as pets (Toynbee, 1973).

Although molluscs were not analysed as part of this study, it is worth mentioning that large amounts of oysters (*Ostrea* sp.), mussels (*Mytilus* sp.), and other marine molluscs were found at the site throughout the Imperial period. They must have represented an important complementary source of food for the inhabitants of the site, favoured by its proximity to the sea in the Roman period.

The consumption of pork decreases in the late 5th-early 6th centuries AD (relative to other food domesticates). This phenomenon, consistent with previous studies of Roman and Late Antique faunal assemblages from Central Italy, may be associated

with a demographic decrease (and hence of meat demand) in the period after the Alaric's sack of Rome in AD 410 (De Grossi Mazzorin, 2004).

Ageing data suggest that suckling piglets were still consumed. However, the majority of the pig population was probably made of sub-adult castrates, ready for slaughter (MacKinnon, 2004; Albarella *et al*., 2011).

Another animal whose relative importance increases in Late Antiquity is the domestic fowl. This may also be part of a countrywide chronological trend, perhaps connected with a greater emphasis on a small-scale economy for which chicken breeding would have been especially suited (De Grossi Mazzorin, 2000). In the context of Spolverino, where the latest phase of occupation shows a clear decline in activities, a diversification of resources geared towards producing low-labour intensive food, such as chicken meat, would have made perfect sense.

Hunting was still practiced in Late Antique Spolverino: red deer and, to a lesser extent, roe deer, fallow deer, hare, and wildfowl all contributed to the human diet. This may be interpreted as the evidence of a small community still living and working in the area of the abandoned manufacturing district. Although archaeology failed to retrieve any substantial trace of dwellings or domestic activities after the dismissal of the workshops, a small necropolis was present (Sebastiani, 2014b); four individuals belonging to the same phase of deposition indicate that a local, rural community continued to live in the immediate surroundings. Furthermore, as some of the areas of the settlement have not been excavated nor exposed, we cannot exclude the persistence of some economic activities or houses in the rooms adjacent to those investigated. The presence of animal bones in the levels of abandonment of the excavated rooms could be the result of dumping activities of a small local community, whose precise physical location is unknown to date.

The bone workshop is unlikely to have still been active in Late Antiquity and the few pieces of worked antlers from this period originate from a stratigraphically insecure context.

The fallow deer

The identification of a fallow deer astragalus is intriguing as this species has infrequently been found in Italy in Roman and/or Late Antique archaeological contexts.

Zooarchaeological studies indicate that the fallow deer disappeared in Italy at the end of the Pleistocene (Masseti & Rustioni, 1988). In historical times, the Romans imported it to central and western Europe (e.g., Britain – Sykes *et al*., 2011; Portugal – Davis & MacKinnon, 2009), from its natural range in western Asia. However, it is questionable whether this amounted to the establishment of self-sustaining populations in the wild.

The Italian peninsula was also affected, though marginally, by this phenomenon of fallow deer expansion. The faunal sample from the Roman site of Castagna (Agrigento, Sicily), contained a relatively high proportion of deer bones, three of which were attributed to the fallow deer (Johnstone, 1997). In the same geographic area, ca. 60 fallow deer postcranial bones were found in 4th-5th century contexts from the agricultural settlement of Campanaio (Agrigento, Sicily) (Wilson, 2000). Besides Sicily, fallow deer remains have also been attested in the Roman contexts of Le Colonne (Grosseto, Tuscany; King, 1985) and at the Roman villas of Ossaia (Arezzo, Tuscany; Bökönyi, 2006), San Potito (Aquila, Abruzzo; Bökönyi, 1986) and Settefinestre (Grosseto, Tuscany; King, 1985).

In the Late Antique context of northern-central Italy, fallow deer remains were recovered from the sites of Monte Barro (Lecco, Lombardy; Baker, 1991) and Monte Gelato (Rome, Latium; King, 1997). In the former site, two amongst 33 cervid antler fragments were identified as fallow deer (Baker, 1991). However, as suggested by the original author of the report (Polydora Baker personal comment, December 2020), due to the variability of deer antler shapes, these identifications require a review. In southern Italy, the fallow deer has been attested at the site of Carminiello ai Mannesi (Naples, Campania; King, 1994) and, tentatively, at Girolamini (Naples, Campania; Albarella, 1988).In the Middle Ages, remains of fallow deer are recorded on a more regular basis (Carenti *et al*., 2015; Masseti & Vernesi, 2015).

With the Roman and Late Antique evidence so sparse, the Spolverino finding is, therefore, noteworthy, especially given the nature of the site. Consequently, the identification needs to be thoroughly justified and discussed. A biometrical analysis has been carried out to verify the morphological identification based on the criteria suggested by Di Ste-

fano (1995) and Lister (1996). Comparative metric data for fallow and red deer derive from the sites listed in the Appendix. The analysis will need to consider that the red deer is on average larger than the fallow deer, but there is a size overlap between the two species. They are both substantially sexually-dimorphic with males larger than females. Female red deer can therefore overlap in size with male fallow deer (e.g. Putman, 1988).

The only recovered astragalus from Spolverino was compared with red deer data from other Italian archaeological sites using the lateral length (GLl) and the distal width (Bd) (Driesch, 1976), common measurements taken on archaeological material (Albarella, 2002).

The scatter plot presented in Figure 9 does not include measurements from Sardinia and Sicily, to avoid the potentially confusing factor of insular dwarfism (Foster, 1964). Despite some variability, all red deer astragali are much larger than the specimen from Spolverino. No comparative measurements from fallow deer astragali were available.

Since the only comparative fallow deer astragalus measurements derive from Sicily and Sardinia, the island data are added in Figure 10. The Spolverino astragalus plots well with the fallow deer specimens, but the distinction with the red deer is in this graph much less clear. This is mainly due to the small red deer from Roman Morgantina (Sicily). The less clear-cut separation between the two species in Figure 10 is unsurprising, in view of the above-mentioned potentially confusing factor of insular dwarfism. Although it is not inconceivable for a very small (female) red deer to have an astragalus of the same size as the one from Spolverino, the combination of morphological and biometrical observations strongly point to the identification of the Spolverino specimen as belonging to a fallow deer.

The Late Antique fallow deer from Spolverino probably represents the remains of game hunted for food by the small community that still lived in the area. The fallow deer was probably initially introduced in the area as prestige exotica. With time, these presumably tamed animals escaped human control and became hunting targets.

The presence of the fallow deer at non-elite sites, such as Spolverino, challenges the possibility that in Roman and Late Antique times viable populations of this species had not yet become established in the Italian countryside. Rural, working sites of low status were unlikely to be able to afford the keeping of exotica for aesthetic or symbolic

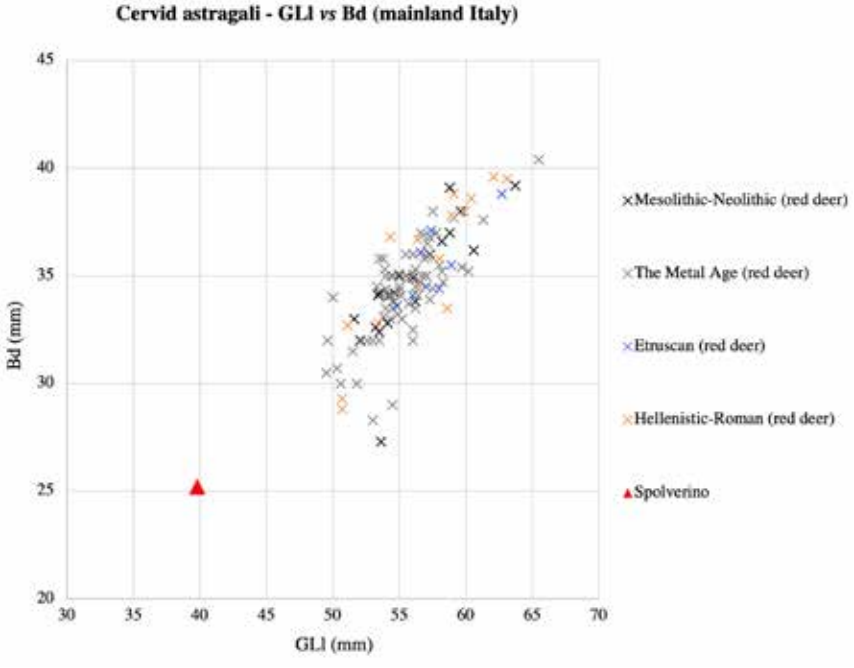

FIGURE 9

Measurements (GLl and Bd) of cervid astragali from the Mesolithic to the Roman period in mainland Italy (see Table 5 for further detail).

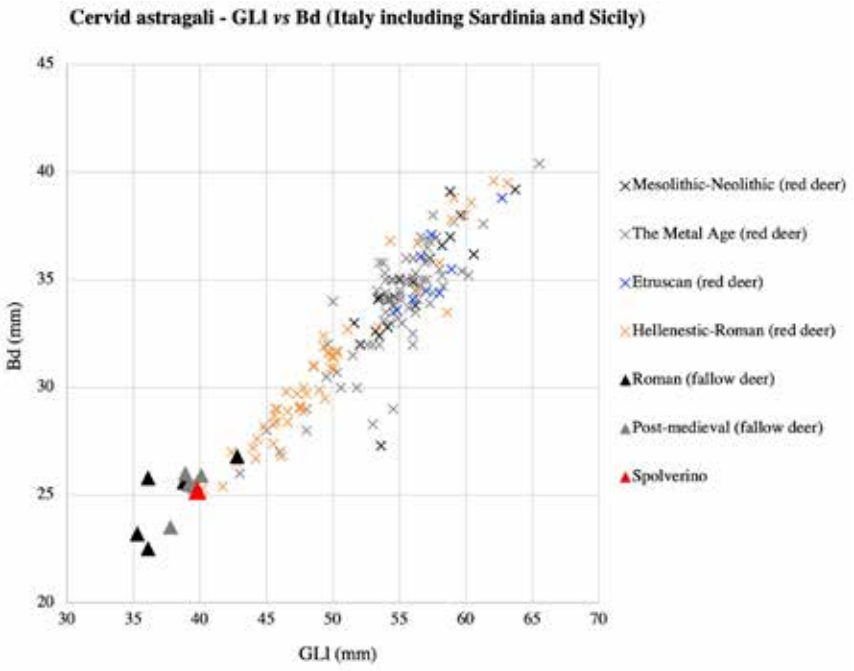

FIGURE 10

Measurements (GLl and Bd) of cervid astragali from archaeological sites dated from the Mesolithic to the Post-medieval period in Italy (for the complete list see Appendix). Values from cervid astragali recovered from archaeological sites located in the islands of Sardinia and Sicily are included.

reasons. The fallow deer may have become part of the Italian wild fauna not in the Middle Ages, but already in late Roman times, if not before.

CONCLUSIONS

The manufacturing community that occupied Spolverino in the Roman Imperial period mainly relied on pork for its meat consumption. Due to the relatively low frequency of cattle and caprines, the local production of secondary products (e.g. milk, wool) would have been of lesser importance; these products, however, could have been introduced to the site. Cattle and equids may have also helped to cultivate the land; local agricultural products were probably stored in the dolia that were found in Period 1.

Animals also provided bones and antlers for the workshop, particularly in the later Imperial period; the abundance of such remains highlights the peculiar nature of the site, along with other evidence for craft activities. However, the pattern of consumption of animal resources does not seem unusual in the region.

By Late Antiquity, the site had lost its original function. This change is also reflected in the zooarchaeological results, which suggest a different system of animal exploitation. The importance of pigs declined, but that of chicken increased. Wild game, including the rare fallow deer and the more common red deer, roe deer, lagomorphs (hare?), wildfowl and tortoises continued being exploited. A small community probably lingered on in the area, but the workshop had become inactive, and a wide range of different resources was used for survival.

This zooarchaeological analysis has provided us with the opportunity to illuminate aspects of the life of a small community in Roman and Late Antique Tuscany, as well as providing information regarding the strategies that it had used to cope with its changing fortunes.

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APPENDIX

ID	Site	Province-Region	Chronology	Species	n° values	References
1	Grotta Continenza	Aquila, Abruzzo	Mesolithic-Neolithic	*Cervus elaphus*	4	Wilkens (1989)
2	Latronico, Grotta 3	Potenza, Basilicata	Mesolithic-Neolithic	*Cervus elaphus*	2	Sorrentino (1978); Wilkens (1989)
3	Maddalena di Muccia	Macerata, Marche	Neolithic	*Cervus elaphus*	1	Barker (1975); Wilkens (1989)
4	Coppetella	Ancona, Marche	Neolithic	*Cervus elaphus*	1	Wilkens (1988a)
5	Cornuda	Treviso, Veneto	Neolithic	*Cervus elaphus*	13	Riedel (1988)
6	Colombare di Negrar	Verona, Veneto	Eneolithic	*Cervus elaphus*	3	Riedel (1976a)
7	Gazzo Veronese	Verona, Veneto	Eneolithic	*Cervus elaphus*	1	Riedel & Rizzi-Zorzi (2005)
8	Ortucchio	Aquila, Abruzzo	Eneolithic	*Cervus elaphus*	1	Wilkens (1989)
9	Appiano	Bolzano, Alto Adige	Bronze Age	*Cervus elaphus*	1	Riedel (1985a)
10	Bachero di Cingoli	Macerata, Abruzzo	Bronze Age	*Cervus elaphus*	1	Wilkens (1989)
11	Barche di Solferino	Mantova, Lombardy	Bronze Age	*Cervus elaphus*	3	Riedel (1976b)
12	Broglio di Trebisacce	Cosenza, Calabria	Bronze Age	*Cervus elaphus*	5	Tagliacozzo (1994)
13	Ficana	Rome, Latium	Bronze Age	*Cervus elaphus*	1	De Grossi Mazzorin (1997)
14	Grotta Cappuccini	Lecce, Puglia	Bronze Age	*Cervus elaphus*	3	Di Martino (2002)
15	Grotta Cardini	Cosenza, Calabria	Bronze Age	*Cervus elaphus*	4	Tagliacozzo & Cassoli (1989)
16	Grotte di Castel Corno	Trento, Trentino Alto Adige	Bronze Age	*Cervus elaphus*	2	Fontana *et al*. (2012)
17	Isolone della Prevaldesca	Verona, Veneto	Bronze Age	*Cervus elaphus*	1	Riedel (1975)
18	Paludi di Celano	Aquila, Marche	Bronze Age	*Cervus elaphus*	5	Agostini *et al*. (1997)
19	Monte Castellaccio	Bologna, Emilia Romagna	Bronze Age	*Cervus elaphus*	4	De Grossi Mazzorin (1996)
20	Olmo di Nogara	Verona, Veneto	Bronze Age	*Cervus elaphus*	2	Salvagno & Tecchiati unpublished
21	Pitigliano	Grosseto, Tuscany	Bronze Age	*Cervus elaphus*	4	De Grossi Mazzorin (1985)
22	Pizzini di Castellano	Trento, Trentino Alto Adige	Bronze Age	*Cervus elaphus*	5	Battisti & Marconi (2004)
23	Punta Terrare	Brindisi, Piglia	Bronze Age	*Cervus elaphus*	1	Wilkens (1989)
24	Santa Paolina di Filottrano	Ancona, Marche	Bronze Age	*Cervus elaphus*	1	Wilkens (1988b, 1989)
25	Villaggio di Ancona	Ancona, Marche	Bronze Age	*Cervus elaphus*	1	Wilkens (1989)
26	Sparne di Poggio Buco	Grosseto, Tuscany	Bronze Age	*Cervus elaphus*	1	Cucinotta & Zanini (2005)

27	Colle dei Cappuccini	Ancona, Marche	Bronze-Iron Age	*Cervus elaphus*	2	Wilkens (1990)
28	Terranegra	Verona, Veneto	Bronze-Iron Age	*Cervus elaphus*	1	Depellegrin & Tecchiati (2016)
29	Monte Zoppega	Verona, Veneto	Bronze-Iron Age	*Cervus elaphus*	1	Riedel (1979)
30	Castelrotto	Verona, Veneto	Iron Age	*Cervus elaphus*	1	Riedel (1985b)
31	Ficana	Rome, Latium	Iron Age	*Cervus elaphus*	1	De Grossi Mazzorin (1997)
32	Colombara di Gazzo Veronese	Verona, Veneto	Iron Age	*Cervus elaphus*	8	Riedel & Tecchiati (2001)
33	Monte Maranfusa	Palermo, Sicily	Iron Age	*Cervus elaphus*	2	Data provided by M. MacKinnon
34	Monteriggioni	Siena, Tuscany	Iron Age	*Cervus elaphus*	1	Bartoloni *et al*. (1997)
35	Nuraghe Sant'Ibenia	Sassari, Sardinia	Iron Age	*Cervus elaphus*	4	Manconi (2000)
36	Ponte Nuovo di Gazzo Veronese	Verona, Veneto	Iron Age	*Cervus elaphus*	1	Tecchiati (2005)
37	Pozzuolo del Friuli	Udine, Friuli Venezia Giulia	Iron Age	*Cervus elaphus*	1	Riedel (1981)
38	Santorso	Vicenza, Veneto	Iron Age	*Cervus elaphus*	1	Cassoli & Tagliacozzo (1990)
39	Forcello di Bagnolo San Vitolo	Mantova, Lombardia	Etruscan	*Cervus elaphus*	8	Trentacoste (2014)
40	Gravina in Puglia	Bari, Puglia	Hellenist-Roman	*Cervus elaphus*	2	Data provided by M. MacKinnon
41	Colognola	Verona, Veneto	Roman	*Cervus elaphus*	2	Riedel (1984)
42	House of C. Julius Polybius	Napoli, Campania	Roman	*Cervus elaphus*	1	Data provided by M. MacKinnon
43	Monfalcone	Gorizia, Friuli Venezia Giulia	Roman	*Cervus elaphus*	2	Petrucci (2012)
44	Morgantina	Enna, Sicilia	Roman	*Cervus elaphus*	38	Data provided by M. MacKinnon
45	Villa di Ossaia	Arezzo, Toscana	Roman	*Cervus elaphus*	6	Data provided by M. MacKinnon
46	San Felice	Bari, Puglia	Roman	*Cervus elaphus*	2	Data provided by M. MacKinnon
47	Turris Libisonis	Sassari, Sardegna	Roman	*Cervus elaphus*	1	Delussu (2005)
48	Campanaio	Agrigento, Sicily	Roman	*Dama dama*	6	Wilson (2000)
49	San Giacomo	Sassari, Sardinia	Post-medieval	*Dama dama*	5	Carenti (2012)

APPENDIX

List of the analysed Italian archaeological sites of which measurements from cervid astragali were used in the analyses.

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