



# Environmental Archaeology

## The Journal of Human Palaeoecology

ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/yenv20>

## The Sicilian Countryside in the Early Middle Ages: Human–Environment Interactions at Contrada Castro

Angelo Castrorao Barba, Claudia Speciale, Roberto Micciché, Filippo Pisciotta, Carla Aleo Nero, Pasquale Marino & Giuseppe Bazan

To cite this article: Angelo Castrorao Barba, Claudia Speciale, Roberto Micciché, Filippo Pisciotta, Carla Aleo Nero, Pasquale Marino & Giuseppe Bazan (2021): The Sicilian Countryside in the Early Middle Ages: Human–Environment Interactions at Contrada Castro, Environmental Archaeology, DOI: [10.1080/14614103.2021.1911768](https://doi.org/10.1080/14614103.2021.1911768)

To link to this article: <https://doi.org/10.1080/14614103.2021.1911768>



© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 12 Apr 2021.



Submit your article to this journal [↗](#)



Article views: 321








View related articles [↗](#)



View Crossmark data [↗](#)

## The Sicilian Countryside in the Early Middle Ages: Human–Environment Interactions at Contrada Castro

Angelo Castrorao Barba <sup>a</sup>, Claudia Speciale <sup>b</sup>, Roberto Micciché <sup>c</sup>, Filippo Pisciotta<sup>d</sup>, Carla Aleo Nero<sup>e</sup>, Pasquale Marino <sup>f</sup> and Giuseppe Bazan <sup>g</sup>

<sup>a</sup>Escuela de Estudios Árabes (EEA), Spanish National Research Council (CSIC), Granada, Spain; <sup>b</sup>Istituto Nazionale di Geofisica e Vulcanologia, Napoli, Italy; <sup>c</sup>History Department, University of Southern Florida, Tampa, FL, USA; <sup>d</sup>UMR 7299 Centre Camille Jullian, Aix-Marseille University (Aix-Marseille Université), Marseille, France; <sup>e</sup>Soprintendenza BB.CC.AA. di Palermo, Regione Siciliana, Palermo, Italy; <sup>f</sup>Bona Furtuna LLC, Los Gatos, USA; <sup>g</sup>STEBICEF, Università degli Studi di Palermo, Palermo, Italy

### ABSTRACT

Within the project ‘Harvesting Memories: Ecology and Archaeology of Monti Sicani Landscapes’, this paper aims to reconstruct human–environment interactions in the inland areas of Western Sicily during the Early Middle Ages through a comparative analysis of environmental archaeological data. We analyse carpological and anthracological finds and faunal remains originating from different layers of the rural settlement of Contrada Castro (Corleone, Palermo), excavated in 2017–2019. The site was mainly occupied between the Byzantine and Islamic periods (late 8th to 11th c. AD). The examination of wood charcoal enabled the identification of plant species selected and exploited in the landscape of the site for each main chronological period. The archaeobotanical data indicated a precise, qualitative picture on the historical vegetation of this area, accompanied with the agricultural practices of the communities. The zooarchaeological data added further information on the reconstruction of rural economy and animal exploitation patterns. An integrated comparison of the characteristic landscape and the archaeobotanical and zooarchaeological data presented the dynamics of agricultural strategy, wood exploitation, and management of animal resources of an early medieval rural community in Western Sicily.

### ARTICLE HISTORY

Received 7 October 2020  
Revised 16 March 2021  
Accepted 18 March 2021

### KEYWORDS

Archaeobotany;  
zooarchaeology; rural  
settlement; Mediterranean  
ecology; Early Medieval  
Sicily; Medieval  
Archaeology; Landscape

## Introduction

In the landscape of Mediterranean archaeology, the geographical and historical contexts of Early Medieval Sicily present interesting interactions between cultures and under different rulers of the Byzantine and Islamic worlds (Davis-Secord 2017). In recent years, research on the chronological frame of the long history of this island has grown consistently through the rereading of historical paradigms (Prigent and Nef 2006), and above all because of an increase in new excavations and the progress made in the archaeological knowledge of the indicators of material culture (Arcifa 2010; Nef, Arcifa, and Bagnera 2012) in the Byzantine and Islamic periods (Molinari 2016, 2019; Arcifa 2018). Investigations of rural settlements in the Sicilian countryside after the end of the Roman villa system (Castrorao Barba 2016) have showed varied dynamics in the reuse of late antiquity villas – such as in the Villa del Casale of Piazza Armerina (Pensabene and Barresi 2019), or the long occupation of secondary settlements along the roadsides – such as in Sofiana/Philosophiana (Vaccaro 2017), or Casale San Pietro (Castrorao Barba 2015; Carver et al. 2019),

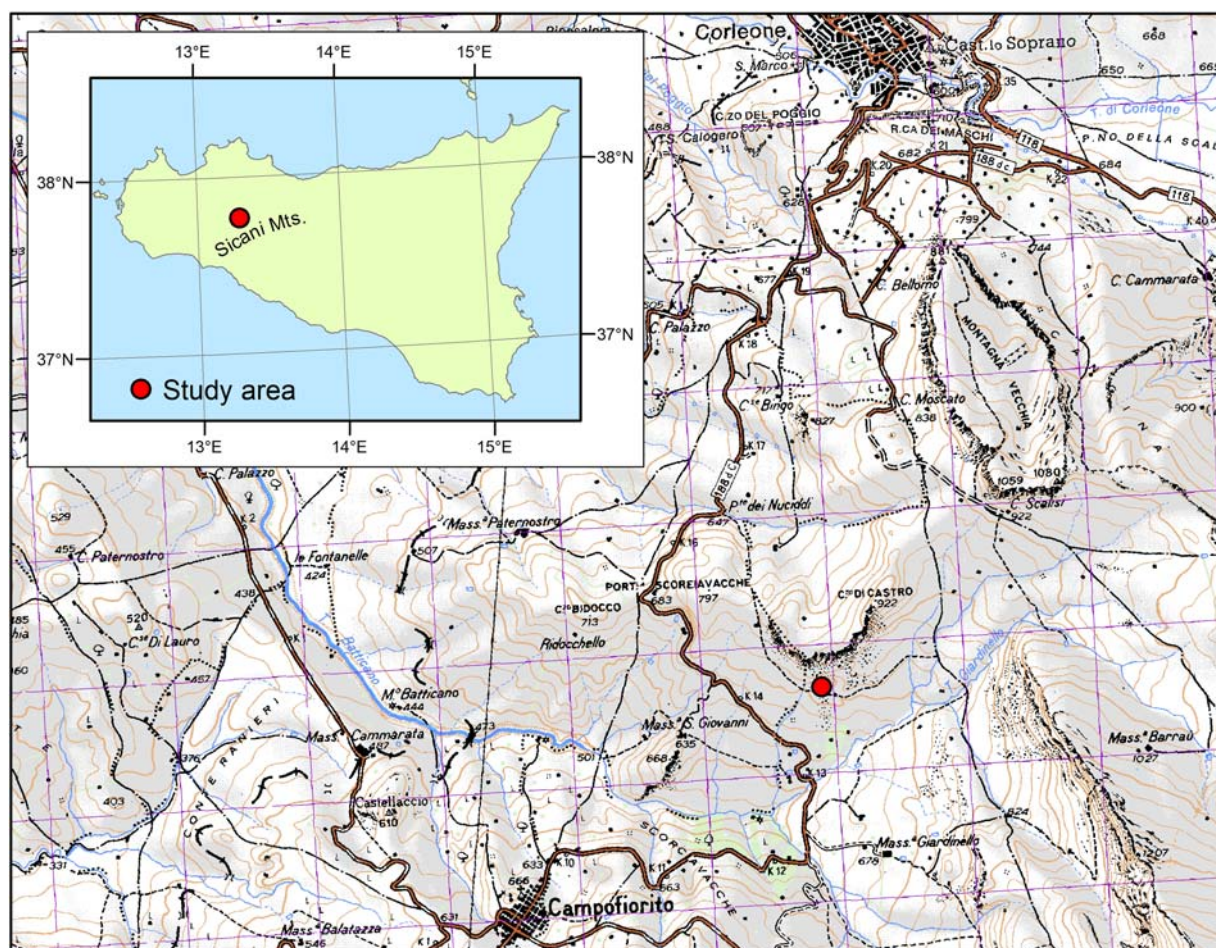
but also in the formation of new open settlements (Colmitella in the territory of Agrigento, Rizzo 2014; or Rocchicella di Mineo in the area of Catania, Arcifa 2016) and fortified *kastra* (the site of Monte Kassar, Vassallo 2009; Carver and Molinari 2016) during the Byzantine period. Less, however, is known about the materiality of the rural settlements that arose in the Islamic age, from the mid-9th to the second half of the 11th c. AD (Molinari 2015). Parallel to the scarcity of investigations of the settlements, little complete research on human–environment interactions – in the sense of the intersection of archaeobotanical, archaeozoological, and ecological data – have been published with consideration of the post-Roman countryside of Sicily, the exceptions being research on Sofiana/*Philosophiana* and the Villa del Casale of Piazza Armerina (Mercuri et al. 2019), and the ongoing ERC (European Research Council) project ‘Sicily in Transition’ (Carver and Molinari 2016).

The project ‘Harvesting Memories: Ecology and Archaeology of Monti Sicani Landscapes’ (Castrorao Barba et al. 2017, 2018a; Bazan et al. 2020a, 2020b) aims to analyse the long-term relationships between

**CONTACT** Angelo Castrorao Barba  [castroraobarba@eea.csic.es](mailto:castroraobarba@eea.csic.es)  Escuela de Estudios Árabes (EEA), Spanish National Research Council (CSIC), Carmen de los Mínimos – C/ Frailes de la Victoria, Granada 18010, Spain

© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.



**Figure 1.** Location of the study area (Contrada Castro archaeological site) on a topographic base map by the Italian Geographic Military Institute (aut. n. 4848 27/07/1998). The U.T.M. grid, in purple, has an interval of 1000 metres.

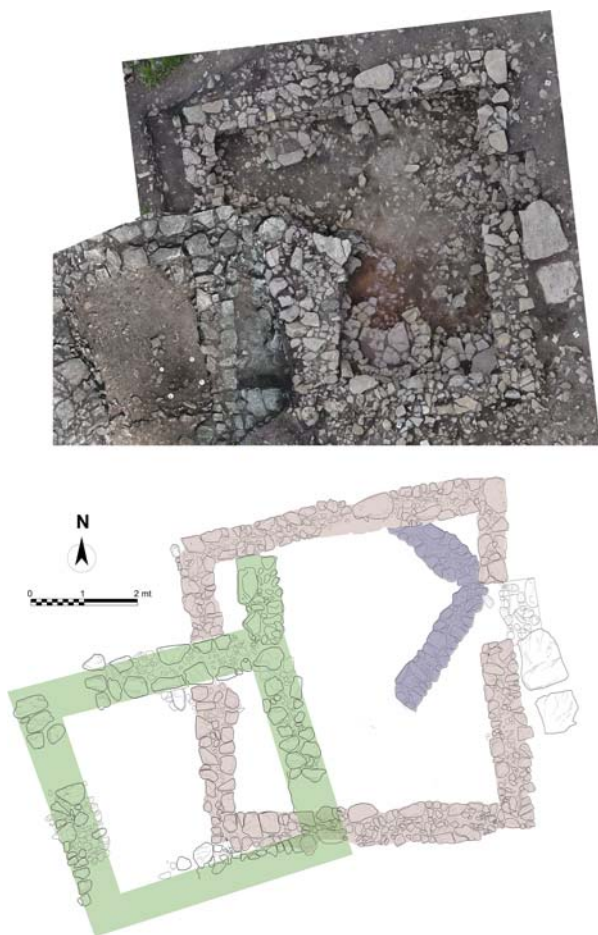
landscape dynamics and settlement patterns in a Mediterranean inland area in Central-Western Sicily (Figure 1). The project focuses specifically on the Early Medieval dynamics of a settlement, discovered in Contrada Castro, in the territory of Corleone in the province of Palermo (Castrorao Barba et al. 2018b, 2018c, 2020). There is no mention of this settlement in the written record. The aim of this paper is to discuss the results of the environmental data (archaeobotanical and zooarchaeological analyses) carried out from the stratigraphic sequence of the excavation in Contrada Castro, dated between late 8th and 11th c. AD, in order to reconstruct historical human-environment interactions and to diachronically understand the complex transition of a rural community between the Byzantine and Islamic periods.

### **The Archaeological Site in Contrada Castro**

From 2017 to 2019 a newly discovered rural settlement was investigated in Contrada Castro (Corleone, Palermo), under the scientific direction of the 'Soprintendenza BB.CC.AA' (Archaeological Heritage Office) of Palermo. The excavations at a hilltop site in Contrada Castro (Castrorao Barba et al. 2018b, 2020)

showed clear evidence of long-term occupation during the Late Archaic/Classical (6th–4th c. BC), Byzantine (late 7th–9th c. AD), and Islamic periods (10th–11th c. AD), as shown in Figure 2. The site occupied a defensible and strategic location while simultaneously directly connecting with underlying valleys, which were potentially exploited for agriculture and may have linked with roads in this area of the Sicani Mountains. This plateau was previously occupied between the 6th and 4th c. BC, after which it was resettled during the Byzantine period. The only evidence of this resettlement is the presence of two infant burials, dated to the late 7th–mid-8th c. AD. The burials were concealed in the late 8th c. AD by the construction of a square building. In its first phase, the building would not have been entirely covered; there were perhaps tiles covering some of its sides. Inside the building, craft activities related to pottery and tile production took place. In fact, on the south side of the building, the remains of two circular pottery kilns have been found and are connected to burnished layers and a good amount of production waste. After this phase, the building was used for housing purposes, not just for production activities. Later, from the first half of the 10th to the 11th c. AD, a radical change in the





**Figure 2.** Excavation at the Contrada Castro settlement: orthophoto and planimetry of the sequence of structures dated back to 6th–4th c. BC (purple), late 8th–9th c. AD (pink) and 10th–11th c. AD (green).

topography of the settlement is recorded, characterised by the presence of new structures which have a different orientation than the previous building. Therefore, the settlement consistency is still to be verified for the beginning of the Norman period (late 11th–early 12th c. AD). Based on currently available data, the site may have remained barely populated, sporadically settled, or even entirely abandoned.



**Figure 3.** A Sicilian inland: the case study area on Contrada Castro (Corleone, Palermo) viewed from the top of Mt Barraù.

## Current Landscape and Ecology

The study area is located in a heterogeneous environmental context, which defines a high diversity of ecosystems and landscapes (Figure 3). The landforms were shaped by frequent changes in geological strata, such as the alternation of clayey or marly hills and calcareous reliefs in the Mesozoic Era (Sicana facies). This has resulted in a sequence of hills with gentle slopes that are irregularly interrupted by isolated mountains with steep and rugged topography (Pizzo Castro) which can reach the considerable height of 1,420 m above sea level (Monte Barraù). The wide elevation range creates a bioclimatic gradient from the lower meso-Mediterranean (upper dry) to the lower supra-Mediterranean (lower subhumid) (Bazan et al. 2015). The plant landscape of this area is composed of four series of climatophilous vegetation and one series of edapho-hygrophilous vegetation (Bazan et al. 2019), which are different in terms of the potential natural vegetation and agrosilvopastoral suitability (Bazan et al. 2020a, 2020b).

The rural landscape is heterogeneous due to its environmental variability and centuries of human activities involving the exploitation of natural resources. In fact, the ecological characteristics offer optimal conditions for agricultural exploitation, forestry, and silvopastoral activities. Today, the area is an example of traditional Mediterranean farmland with a mosaic of arable land, olive groves, vineyards, mixed crops, fruit orchards, and agroforestry systems. The remnant forest formation consists of holm oak woods (*Ampelodesmo mauritanici*–*Quercetum ilicis* and *Sorbo torminalis*–*Quercetum ilicis*) and downy oak woods (*Oleo oleaster*–*Quercetum virgilianae* and *Sorbo torminalis*–*Quercetum virgilianae*). Along the river valleys (Giardinello and Batticano streams) grow hygrophilous forests with poplars and willows (*Ulmo canescentis*–*Salicetum pedicellatae*). The rupestral and semi-rupestral stations exposed to the south, are characterised by wild olive associated with sclerophyllous elements (Gianguzzi and Bazan 2019, 2020). A larger surface is covered by a mosaic of several natural pasture habitats, both thermophilous (*Ampelodesmos mauritanicus* grassland) and mesophilous, grazed by cattle, goats, and sheep (Bazan et al. 2020b).

## Materials and Methods

### Stratigraphic Contexts and Radiocarbon Dating

The stratigraphic sequence of the site was subdivided into two main periods, within which different archaeological layers (stratigraphic units, SU) were recorded:

- Period A (late 8th–9th c. AD): SU 9, SU 12, SU 14, SU 37, SU 40; SU 42, SU 43, SU 47, SU 49, SU 51, SU 61.

- Period B (10th–11th c. AD): SU 1, SU 2, SU 8, SU 36, SU 1003, SU 1014.

A typological study of pottery from the site confirmed the absolute chronology of the two periods (Castrorao Barba et al. 2020), which is consistent with the results of radiocarbon analyses on bones and charcoal (performed at the INNOVA SCaRL laboratory of the Department of Mathematics and Physics, Second University of Naples). In fact, the building associated with Period A was built on top of perinatal burials dated at 1-sigma 662–778 AD. Charcoal residue of *Pistacia* sp. (probably terebinth) sampled from the burned context of the kiln activity gave a radiocarbon dating of 1-sigma 774–878 AD. Animal bones from the collapsed layer of the building provided the date of 1-sigma 800–878 AD. A sample of animal bone from a Period B layer was dated back to 1-sigma 965–1042 AD.

### Archaeobotany

The soil samples for this study were collected during the 2017 and 2019 excavations and used random sampling so that the different SU could be randomly subsampled (D'Alpoim Guedes and Spengler 2015). Soil samples of a similar volume, of about 8–15 litres, were collected for each SU. The quantity of soil sampled for each SU has been considered adequate on the basis of the consistent density of the macroremains in every SU and it is coherent with sampling strategies carried out in other excavations of Southern Italy (e.g. Stika, Heiss, and Zach 2008; Costantini and Costantini Biasini 2010; Lentjes 2016). The total volume of sediment wet sieved for period A was 82 litres, and for period B it was 90 litres.

The samples were floated at the Botanical Garden of Palermo, using two different sieves with a larger and narrower mesh (5 and 0.5 mm, respectively) to separate the plant remains from the clayey soil matrix. Subsequently, the samples were screened using a binocular stereo microscope at the STEBICEF Department of the University of Palermo.

The tendencies of the volume and density of identified wood charcoals were quite similar (the average density per SU was similar as well), with the exception of SU 43 for which the density was much higher; SU 12, SU 49, SU 52, and SU 61 for which the density was higher; and SU 36, SU 37, SU 1, and SU 2 for which the density was much lower.

For the identification of the wood genera and species, a comparison was performed using reference atlases (Cambini 1967; Schweingruber 1990; Nardi-Berti 2006), scientific literature (i.e. Asouti et al. 2015), and tools available online (*InsideWood* and *Microscopic Wood Anatomy*), as well as with reference

samples which were not available for all species. The oaks cannot be distinguished at the species level based solely on their wood anatomy (Cambini 1967); however, the environmental characteristic of the Sicani Mountains (climate, lithology, elevation, etc.) and knowledge of the flora (current and historical) of this part of Sicily allow us to assign the species with high confidence. The Cappers and Neef (2012, 2016) atlases were adopted for the identification of the genus and species of seeds and fruits; Cappers (2018) atlas and a personal comparative collection were used for cereals.

Each wood charcoal sample was observed in cross section and tangential section at a maximum of 40× magnification, and measured by the two dimensions so as to have a reference of the surfaces analysed and to obtain a value of the total volumes by species, and therefore their incidence at the numerical level, as well as the actual quantitative ratio of the total (see e.g. Chabal 1994; Thery-Parisot, Chabal, and Chravzez 2010). The application of this method can help overcome quantitative errors, for example due to the greater or smaller fragmentation rate of some species, or the variability of the volume of wood charcoal samples, which can vary from a few mm<sup>3</sup> to some cm<sup>3</sup>. Where possible, the diameters of some small branches were measured.

Not all wood charcoals were observed at this stage, but rather only a significant portion per SU, considering that the specific variability, when exceeding 13–15 charcoal remains per SU, does not increase.

The charred seeds and fruit remains were observed in frontal, dorsal, and lateral sections, and classified into three categories: cereals, legumes, and fruits.

### Zooarchaeology

The zooarchaeological study for this paper was mostly focused on the investigation of the exploitation of animal resources at the site during its two main periods of occupation (A and B), and on the evaluation of changes in husbandry strategies and management of livestock. The zooarchaeological samples were collected during the 2017, 2018, and 2019 excavation campaigns. As a sampling strategy, we opted to recover the animal remains by hand. At large, the taxonomic attribution was carried out using several osteological atlases and an osteological reference collection available at the Laboratory of Anthropology and Forensics Application of the STEBICEF Department of the University of Palermo. The taxonomic abundance of the sample was mainly assessed by counting the number of identified specimens (NISP) (Grayson 1978). To reduce difficulties in relation to aggregation, the minimum number of individuals (MNI) was calculated by dividing the sample into two macro-groups: one that included all contexts dated to the late 8th–9th c. AD (Period A), and a

second which referred to the contexts of the 10th–11th c. AD (Period B). The calculation of the MNI followed the specifications proposed by White (1953). The distinction between sheep and goats, which is still one of the most problematic issues in zooarchaeology (Salvagno and Albarella 2017), was carried out by relying on the slight morphological differences expressed in the dentition and some elements of the postcranial skeleton, as suggested by the studies of Boessneck (1970), Zeder and Lapham (2010), and Zeder and Pilaar (2010). Likewise, the equid bones were specifically attributed to the taxa of donkey, horse, or hybrid, mostly relying on morphological features of the postcranial skeleton (Hanot and Bochaton 2018) and dental enamel patterns of the occlusal surface (e.g. presence or absence of the caballine fold). The degree of completeness of each identified set of remains was recorded using the diagnostic zone system (Dobney and Rielly 1988). Age at death was assigned by examination of the ontogenic stage of the teeth and degree of wear, as well as the evaluation of the state of fusion of the bones (Silver 1969; Payne 1973; Habermehl 1975; Grant 1982). Where possible, osteometric measurements were carried out according to the standards suggested by von den Driesch (1976).

The recording of signs of butchery on bones followed a criterion that provided for their precise anatomical location and classification according to the instrument that most likely produced them, distinguishing between hack marks (e.g. axe or cleaver), cut marks (e.g. knife), and saw marks (e.g. saw).

## Results

### Human–Crop Interactions: Carpological Data

For seeds/fruits, 271 archaeobotanical remains were recorded. Of these, less than 5% were unidentified. Considering the taxonomically identified remains (258 samples), the highest percentage consisted of cereals (74.42%); 23.64% of the samples were legumes; and the remaining 1.94% can be divided into fruits (0.78%), a fragmentary seed of Cucurbitaceae (0.39%), and weeds (0.78%). These results are shown in Table 1 and Figure 4.

Most of the analysed findings were concentrated in layers SU 52 (Period A) and SU 1003 (Period B). These two SU have showed a higher concentration of macroremains; in particular the SU 1003 has been interpreted as a fire place in which also cooking pots has been found. The grains do not appear to be subject to particular fragmentation or granulation activities, but many are unidentified due to the high combustion distortion. Cereals and legumes from layer 1003 were an exception, as they were not overly fragmented.

For the late 8th–9th c. AD (Period A), 28.89% of the remains were naked wheats (*Triticum aestivum* and *T. durum*, grouped together in one category), hulled

**Table 1.** Total count of taxa per chronological period: A (late 8th–9th century AD); B (10th–11th century AD). Each column shows the indication of the absolute number of seeds and their incidence as a percentage of the total per period.

Taxa	Period A count (n)	%	Period B count (n)	%
Wheats ( <i>Triticum</i> sp.)	25	13.89	7	7.69
Einkorn ( <i>T. monococcum</i> L.)	1	0.56	0	–
Emmer ( <i>T. dicoccum</i> (Schränk.) Schuebl.)	12	6.67	3	3.30
Naked wheats ( <i>T. aestivum</i> L./ <i>T. durum</i> Desf.)	52	28.89	30	32.97
Barley ( <i>Hordeum vulgare</i> L.)	10	5.56	7	7.69
Rye ( <i>Secale cereale</i> L.)	9	5.00	–	–
Weeds (Poaceae)	36	20.00	–	–
Fava bean ( <i>Vicia faba</i> L. var. <i>major</i> (Harz) Beck)	6	3.33	15	16.48
Chickling vetch ( <i>Lathyrus</i> sp.)	8	4.44	7	7.69
Vetch ( <i>Vicia</i> sp.)	1	0.56	–	–
Ervil ( <i>Vicia ervilia</i> (L.) Willd.)	1	0.56	6	6.59
Chickpea ( <i>Cicer arietinum</i> L.)	3	1.67	7	7.69
Pea ( <i>Pisum sativum</i> L.)	2	1.11	0	–
Lentil ( <i>Lens culinaris</i> Medik.)	1	0.56	4	4.40
Small pulses (Fabaceae, <5 mm)	2	1.11	–	–
Cucurbits (Cucurbitaceae)	1	0.56	–	–
Plum ( <i>Prunus</i> sp.)	1	0.56	–	–
Grapes ( <i>Vitis vinifera</i> L.)	1	0.56	–	–
Non id.	8	4.44	5	5.49
	180	100	91	100

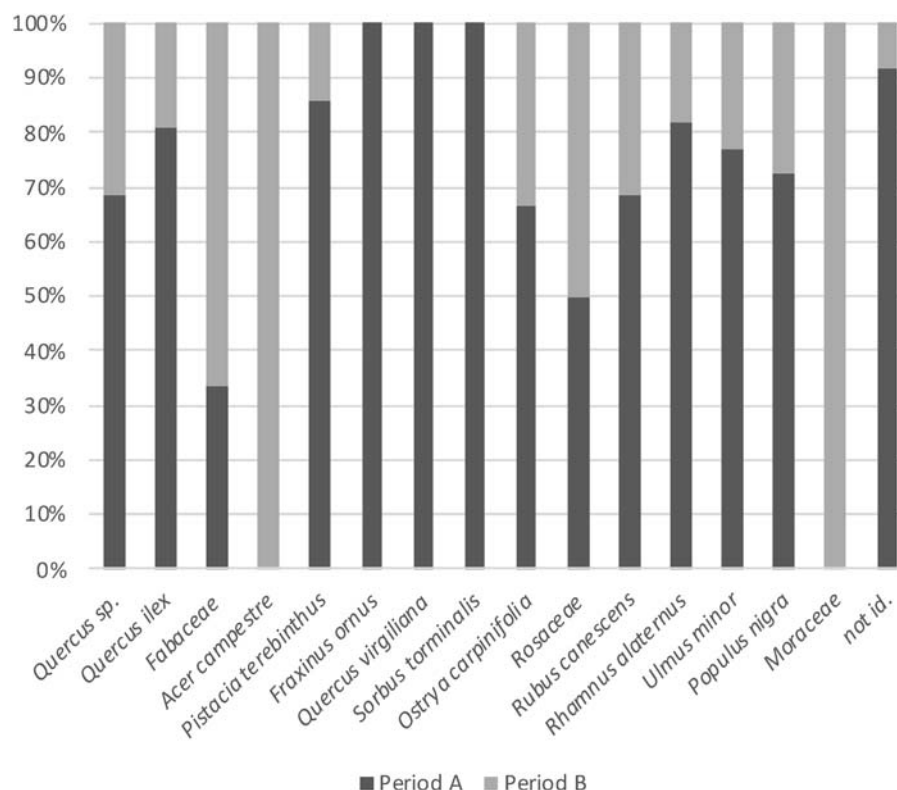
wheats (*T. monococcum* and *T. dicoccum*) represented 7.23%, unidentified wheats 13.89% (*Triticum* sp.), and unidentified cereals 20% (Poaceae); rye (*Secale cereale*) and barley (*Hordeum vulgare*) represented 5% and 5.56%, respectively. The total percentage of cereals for Period A was 70.01%, and legumes 13.34%, among which we identified chickling vetch (*Lathyrus* sp.) with 4.44%, fava beans (*Vicia faba*) with 3.33%, chickpeas (*Cicer arietinum*) with 1.67%, peas (*Pisum sativum*) with 1.11%, vetch (*Vicia ervilia*) with 1.11%, and lentils (*Lens culinaris*) with 0.56%. Only during Period A did we find evidence of individual seeds of cucurbit, grape, and a single specimen of genus *Prunus*.

During Period B (10th–11th c. AD), naked wheats were still the highest represented group of cereals, with 32.97% of the total; hulled wheats were 3.30%; and unidentified wheats 7.69%. Barley was present at 7.69% of the total. Cereals were 51.65% of the total documented for Period B. The presence of fava beans was highly attested with a total of 16.48%, chickpeas were present at 7.79%, chickling vetch 7.68%, vetch 6.59%, and lentils 4.40%. The total of all legumes amounted to 42.94%. Despite the specificity of the SU 1003 context (likely the remains of a roasting structure), the representativity of legumes in Period B seems to be much higher.

### Human–Wood Interactions: Anthracological Data

The overall taxonomic variability of the wood charcoal recovered at the site, was found to be similar to the composition of the present-day plant landscape of the area. No species were present which did not also occur in the modern-day environment of this area.





**Figure 4.** Comparison of seeds/fruits record between Periods A and B.

In Period A, the holm oak (*Quercus ilex*) dominated, totalling 35.14% of the samples (and 72.38% of the oaks), and together with the other oaks constituted 48.55% of the total sample. This was followed by terebinth with 8.7%, and all other species between 1% and 5% of the sample (Table 2). Manna ash (*Fraxinus ornus*), downy oak (*Quercus virgiliana*), and wild service tree (*Sorbus torminalis*) were only present in the layers of Period A with an incidence of 1.45%, 3.99%, and 3.26%, respectively (Table 2, Figure 5).

For Period B, the holm oak continued to be the most represented species with 32.86% of the total. Bramble s.l. (*Rubus* sp.) and terebinth (*Pistacia*

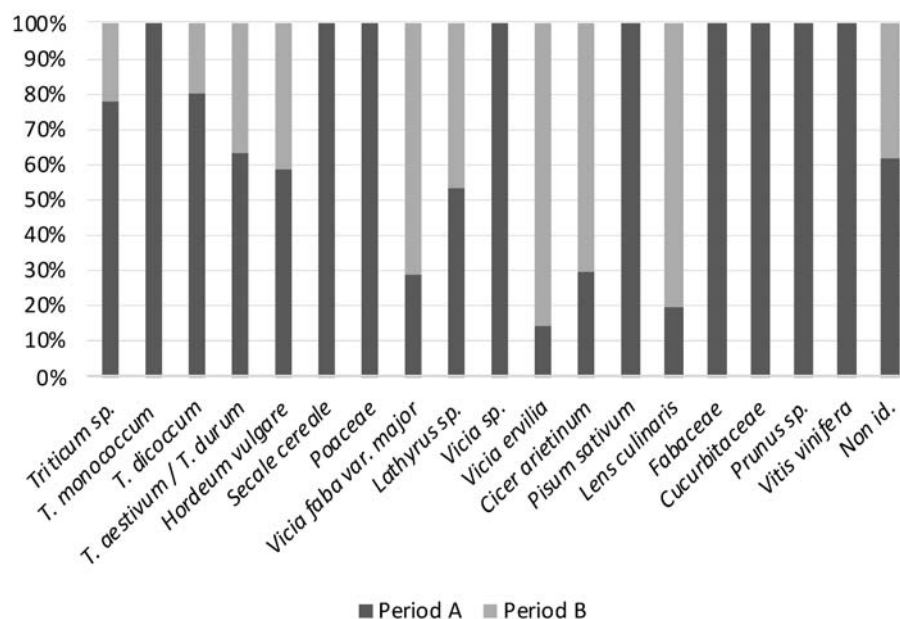
*terebinthus*) were the other species identified with a significant representativeness of 8.57% and 5.71% respectively. Furthermore, field maple (*Acer campestre*), with 2.86%, and Moraceae, with 4.29%, were identified only in Period B contexts.

### Human–Animal Interactions: Zooarchaeological Data

The entire sample used for analysis comprised of 1,663 components of animal remains, of which 777 (47%) were attributed at the species level (Table 3). The remaining 886 fragments were incorporated into

**Table 2.** Total count of taxa per chronological period: A (late 8th–9th century AD); B (10th–11th century AD). Each column shows the indication of the absolute number of wood charcoals; their volumes in mm<sup>3</sup>; and their incidence as a percentage of the total per period.

Taxa	Period A			Period B		
	count (n)	vol (mm <sup>3</sup> )	%	count (n)	vol (mm <sup>3</sup> )	%
Oak ( <i>Quercus</i> sp.)	26	2149	9.42	12	449	17.14
Holm oak ( <i>Quercus ilex</i> L.)	97	6350	35.14	23	1547	32.86
Legumes (Fabaceae)	1	30	0.36	2	181	2.86
Field maple ( <i>Acer campestre</i> L.)	–	–	–	2	95	2.86
Terebinth ( <i>Pistacia terebinthus</i> L.)	24	1161	8.7	4	40	5.71
Manna ash ( <i>Fraxinus ornus</i> L.)	4	98	1.45	–	–	–
Downy oak ( <i>Quercus virgiliana</i> (Ten.) Ten.)	11	647	3.99	–	–	–
Wild service tree ( <i>Sorbus torminalis</i> (L.) Crantz)	9	342	3.26	–	–	–
European hop-hornbeam ( <i>Ostrya carpinifolia</i> Scop.)	6	447	2.17	3	120	4.29
Plum trees (Rosaceae Prunoideae)	2	64	0.72	2	42	2.86
Bramble s.l. ( <i>Rubus</i> sp.)	13	600	4.71	6	252	8.57
Buckthorn ( <i>Rhamnus alaternus</i> L.)	9	546	3.26	2	42	2.86
Field elm ( <i>Ulmus minor</i> Mill.)	10	616	3.62	3	148	4.29
Black poplar ( <i>Populus nigra</i> L.)	8	684	2.9	3	18	4.29
Mulberry family (Moraceae)	–	–	–	3	87	4.29
Not id.	56	2684	20.29	5	108	7.14
	276	16,418	100	70	3129	100



**Figure 5.** Comparison of wood charcoal record between Periods A and B.

larger groups, which were an expression of the size of the unidentified animal (e.g. large mammals, mid-sized birds, etc.).

The state of preservation of the recovered remains was generally good, and the surface of the bones did not show any particular traces of diagenetic alteration or root etching. However, a high number of the elements recorded did show signs of biological damage. Indeed, almost 35% of the identified elements bore strong evidence of carnivore gnawing, frequently localised on the epiphyses of the long bones, and most likely caused by dogs. A possible explanation for the high frequency of gnawed bones could be traced back to the use of food remains and/or butchery refuse for feeding the dogs. However, it could also be

connected with a waste disposal system that did not foresee the need for a specifically designated area. It is interesting to note that the widespread presence of dogs inferred from the traces of gnawing is not reflected in the taxonomic distribution of the faunal assemblage, where the dog is represented by a single fragment of bone.

The indications of human activity were connected to butchery practices, and mostly were evident as dismembering marks made with large tools, such as cleavers and axes.

The overall taxonomic distribution of the faunal assemblage was substantially dominated by domestic species, accounting for almost 95% of the identified elements. The presence of wild species can be

**Table 3.** Total count of animal remains recovered at Castro for the two main periods of occupation at the site (Period A, late 8th–9th c. AD; Period B, 10th–11th c. AD).

Taxa	Period A				Period B			
	NISP	%NISP	MNI	%MNI	NISP	%NISP	MNI	%MNI
Cattle ( <i>Bos taurus</i> )	34	25.76%	3	23.08%	150	22.22%	7	11.86%
Pig ( <i>Sus domesticus</i> )	27	20.45%	2	15.38%	116	17.19%	7	11.86%
Caprovine ( <i>Ovis/Capra</i> )	53	40.15%	3	23.08%	260	38.52%	16	27.12%
Sheep ( <i>Ovis aries</i> )	10	7.58%	2	15.38%	56	8.30%	15	25.42%
Goat ( <i>Capra hircus</i> )	3	2.27%	1	7.69%	12	1.78%	2	3.39%
Donkey ( <i>Equus cf. asinus</i> )	–	–	–	–	43	6.37%	2	3.39%
Dog ( <i>Canis familiaris</i> )	–	–	–	–	1	0.15%	1	1.69%
Cat ( <i>Felis silvestris</i> )	–	–	–	–	1	0.15%	1	1.69%
Wild boar ( <i>Sus scrofa</i> )	–	–	–	–	3	0.44%	2	3.39%
Deer ( <i>Cervus/Dama</i> )	1	0.76%	1	7.69%	14	2.07%	2	3.39%
Fox ( <i>Vulpes vulpes</i> )	–	–	–	–	1	0.15%	1	1.69%
Chicken ( <i>Gallus gallus</i> )	4	3.03%	1	7.69%	18	2.67%	3	5.08%
Tot. Identified	132	100%	13	100%	675	100%	59	100%
Bird middle size	8	5.88%	–	–	4	0.53%	–	–
Bird small size	3	2.21%	–	–	–	0.00%	–	–
Mammal large	25	18.38%	–	–	207	27.60%	–	–
Mammal medium	98	72.06%	–	–	538	71.73%	–	–
Mammal small	2	1.47%	–	–	1	0.13%	–	–
Tot. unidentified	136	100.0%	–	–	750	100%	–	–
Grand Total	268				1425			



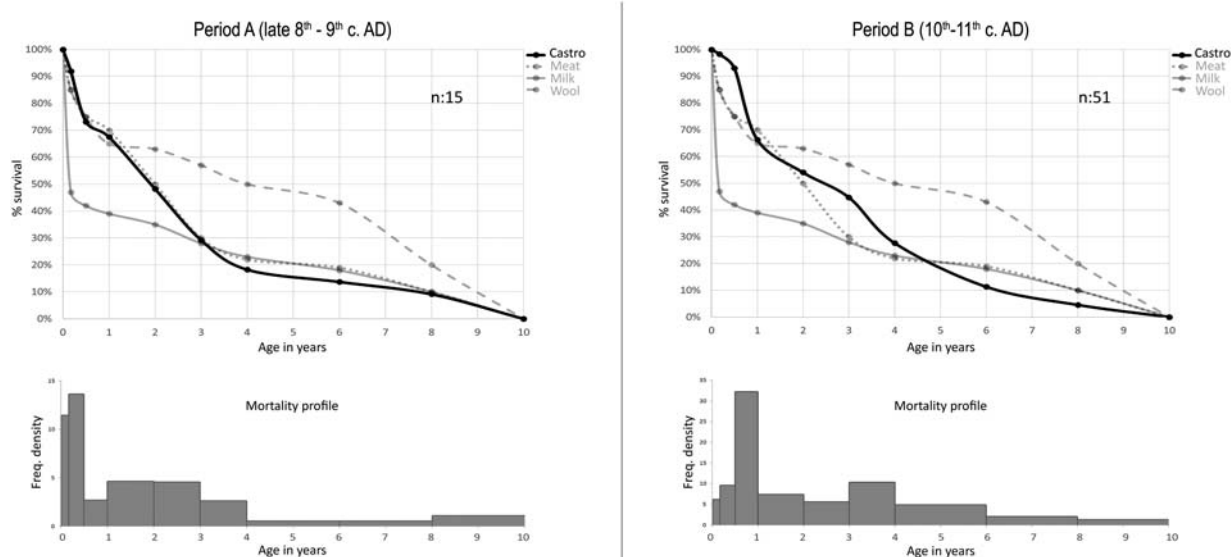
considered sporadic and was mainly represented by deer (*Cervus elaphus/Dama dama*) and wild boar. However, the presence of the latter may have been underestimated due to the known difficulties of assigning anatomical elements to the pig or boar, arising from the numerous anatomical similarities shared by the taxa (Rowley-Conwy, Albarella, and Dobney 2012).

Periods A and B substantially showed the same species distributions for the main domesticated animals (Table 3). Indeed, referring to the so-called domestic triad (*Bos*, *Sus*, and *Ovis/Capra*), the group most represented across both periods was the caprine species, with a ratio of sheep to goat of almost 8:1. The category of caprines (*Ovis/Capra*) constituted about half of the faunal assemblages, while cattle (*Bos taurus*) and pigs (*Sus domesticus*) accounted for 22% and 18%, respectively. The only element of discontinuity was the presence of the donkey (*Equus asinus*) in the Period B sample. The donkey remains accounted for 6.37% of the identified elements and belonged to at least two individuals. The bones did not show any traces of butchery and were almost representative of all the anatomical zones of the animal, which most likely excludes its use as a food source. The majority of the remains attributed to the donkey came from the same SU (2) and, although disarticulated and scattered, were spatially distributed in a well-delimited area of the excavation. SU 2 and the overlying SU 1 have been the most severely damaged layers due to modern agricultural exploitation. Therefore, it is highly plausible that the original deposition was referring to a complete animal in anatomical connection. This datum would be further confirmed by osteometry as the left–right paired skeletal elements of the donkey showed almost the same metric values.

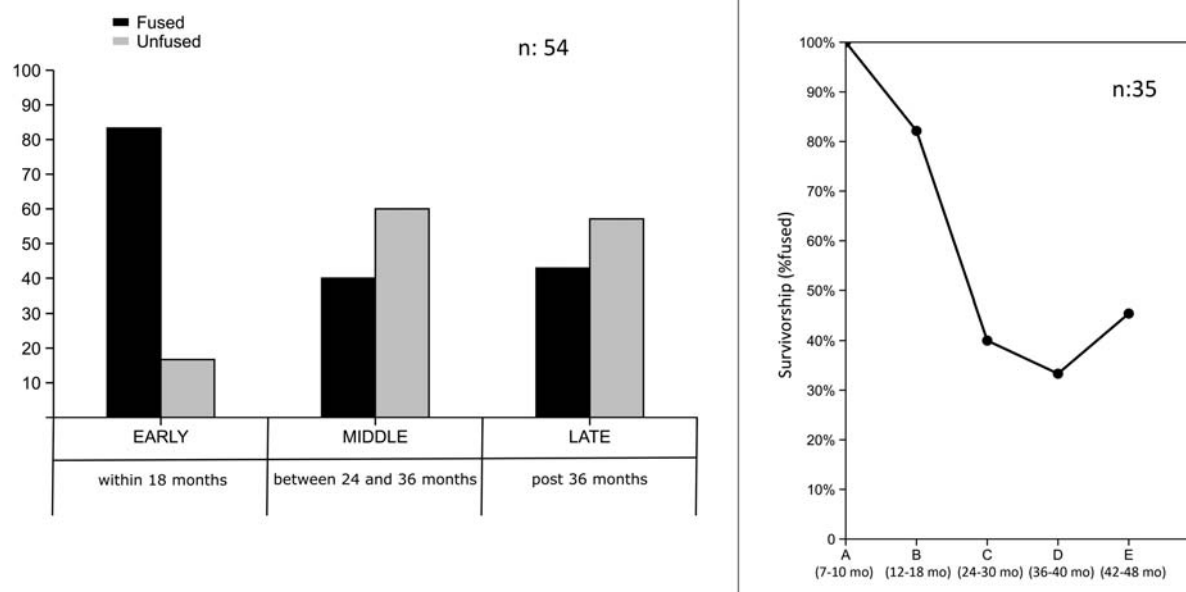
It was possible to analyse kill-off patterns only for the caprine group using an intra-site diachronic perspective (Figure 6). Based on this analysis, the mortality profiles and survival curves showed clear analogies between the two periods. According to models proposed by Payne (1973), flock management was considered to mostly address meat production. However, for Period B we noted a slight shift in the culling strategies towards individuals aged 3–4 years.

The age at death for cattle was attributed based on the degree of bone fusion. The demographic assessment of cattle during Period B (Figure 7) highlights that approximately 45% of cattle survived past the age of 48 months (which is when fusion of the last fusing elements takes place). Furthermore, some remains, accounting for 16% of this taxon, belonged to individuals slaughtered within the first 18 months.

The analysis of the distribution of body parts and butchery marks on bone can provide information on the role of animals as a food source, allowing us to better characterise the social and cultural structure of the community that inhabited the site of Contrada Castro during the 10th–11th c. AD. All areas of the skeletons were represented (Figure 8A). However, most of the recovered skeletal elements belonged to the forequarter and shanks. The cuts of meat associated with these parts have a considerable presence of connective tissue and cartilages, therefore requiring prolonged cooking, which makes them particularly suitable for the preparation of stews and broths. Butchery traces were mostly associated with the use of heavy tools (cleavers and axes), which are functional to the dismemberment of carcasses. For all three major domestic species, the area most affected by heavy toolmarks fell roughly between the distal part of the humerus and the proximal part of the radius and ulna. Regarding cattle



**Figure 6.** Comparison of caprine animals' killing patterns between Periods A and B, according to the model of meat, milk and wool exploitation of the flock proposed by Payne (1973).



**Figure 7.** Mortality and survivorship curve for cattle in the 10th–11th c. AD. Fusion stage A = distal scapula; B = proximal radius, distal humerus, proximal phalanges; C = distal tibia, distal metacarpus; D = calcaneus; E = proximal tibia, distal femur, distal radius, proximal ulna.

and the caprine group, further traces of dismemberment were also found at the joint between the femur and the tibia, although often located on the proximal metaphysis of the latter.

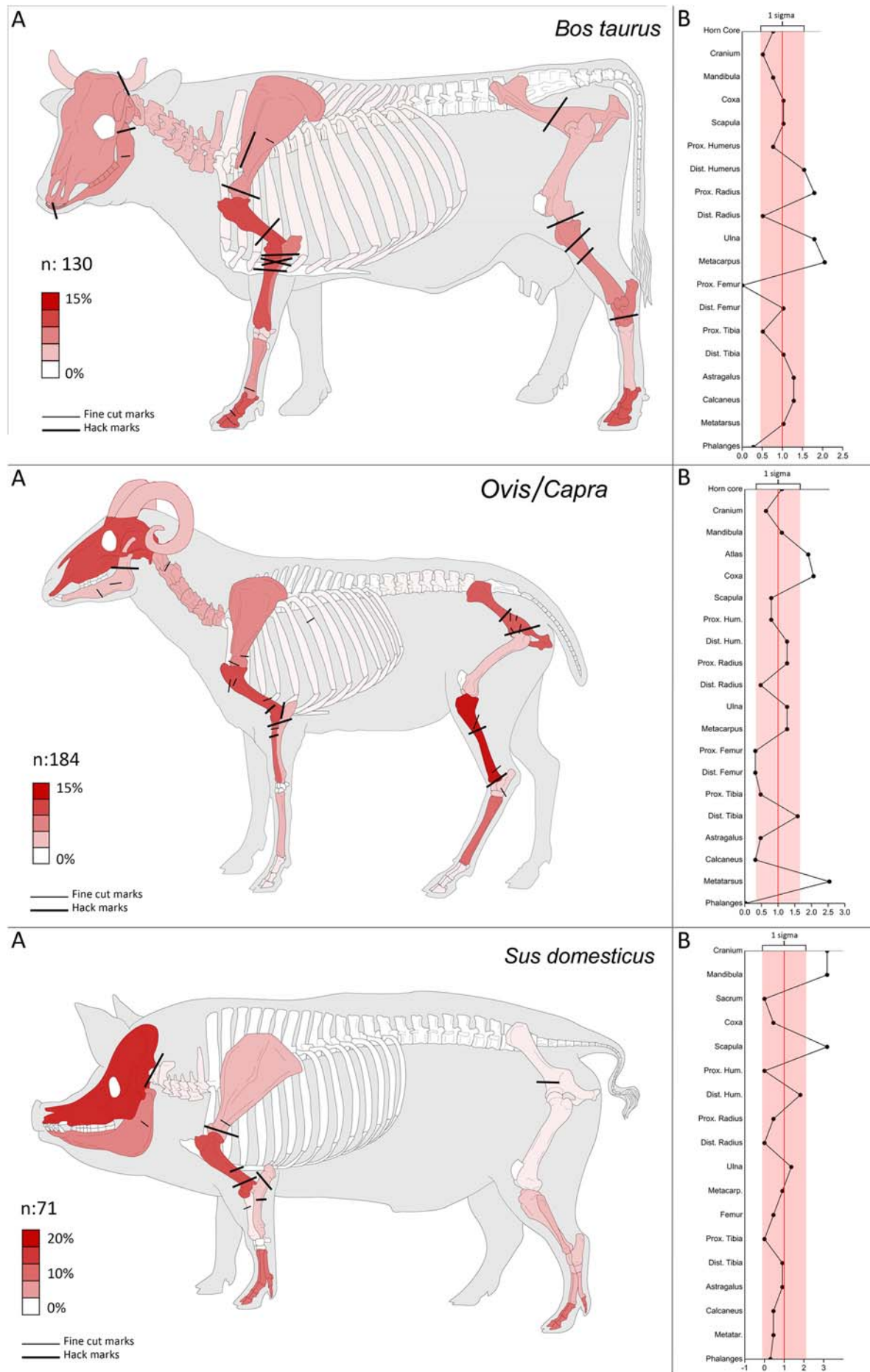
## Discussion

The analysis of the archaeo-environmental data does not indicate a radical or clear discontinuity between the two periods. This indicates a tendency to adapt well to the landscape characteristics and the area's potential suitability for certain practices (Figure 9). The observed continuity in the general trends of local resource exploitation and agricultural and livestock strategies is not, however, entirely without differences. These differences may be helpful to better understand the evolution of the complexity of managing environmental resources in the transition from late 8th–9th (Period A) to the 10th–11th c. AD (Period B). These trends of continuity and differences are observed in the carpological, anthracological, and zooarchaeological records.

Agricultural exploitation is documented in the recovered charred seeds of varieties of cereals and legumes, which are representative of cultivation in the area. The carpological data indicates the prevalence of wheat in the cereal diets in both Periods A and B. The genus *Triticum* (wheat in the generic sense) identified in the samples belongs to the small- and medium-hulled varieties (*T. monococcum* and *T. dicoccum*), and also to naked varieties, although it is in some cases not possible to clearly distinguish between *T. aestivum* ('common' or 'bread wheat') and/or *T. durum* ('durum' or 'pasta wheat'). The

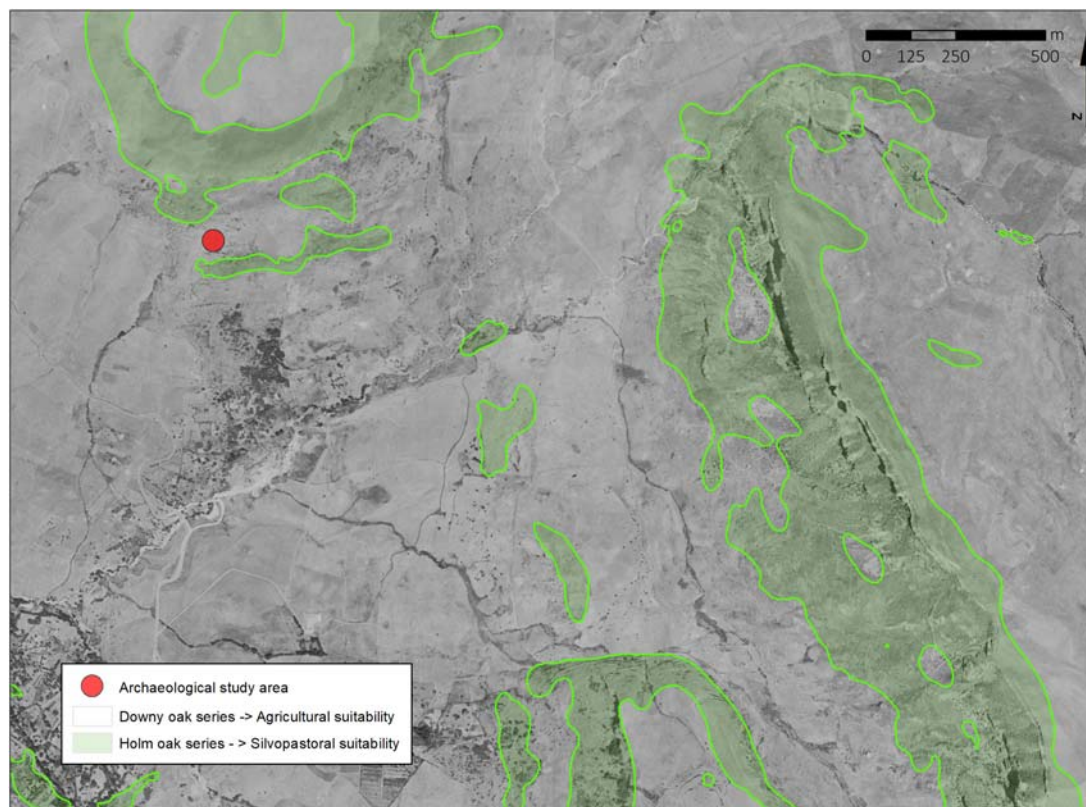
introduction of durum wheat in the central-western Mediterranean has been subject to some debate (see e.g. Decker 2009), but data from this site so far cannot better define its preference or choice upon *Triticum aestivum*. In Contrada Castro the presence of naked wheat is prevalent but hulled grains also constitute a significant percentage, similar to that of Segesta (12th c. AD) (Castiglioni and Rottoli 1997), but unlike other medieval sites in Sicily such as Monte Polizzo (11th–12th c. AD), where the presence of naked wheats is almost exclusive (Stika, Heiss, and Zach 2008), as well as Brucato (14th c. AD), where the presence of naked grains and durum wheat in particular is very widespread (Bossard-Beck 1984). The relevance of hulled grains could be possibly explained by the persistence of food traditions or other agricultural choices.

Another cereal present across Periods A and B at Contrada Castro, although less represented than wheat, is barley. The caryopses of hulled barley (*Hordeum vulgare*) all seem to belong to the same taxon (probably *H. vulgare* subsp. *vulgare*), which is the most productive subspecies. There are different perspectives on the use of barley for human nutrition and, in many cases, it has been considered a poorer food, or used as animal fodder (see e.g. Beolchini et al. 2018). In Contrada Castro it is not possible to clearly separate the consumption of barley by humans or animals, but the presence of domestic animals may be compatible with its exploitation as fodder, and its co-occurrence in SU 52 (Period A) with other cereals and legumes. Together with the sporadic presence of rye, this could be interpreted as the presence of arable weeds rather than as intentionally cultivated species.



**Figure 8.** (A) Distribution of body parts for the main domestic animals during the 10th–11th c. AD (silhouettes modified from Barone 1976). (B) Ratio between the observed and expected distribution of body parts, after O'Connor (2000, 71–75).





**Figure 9.** The land suitability of the inland of Monti Sicani, around the Contrada Castro site, is recognised in terms of vegetation series. Most of the area shows an agricultural suitability. The polygons overlap an aerial photograph taken in the 1950s by the Italian Military Geographic Institute, which shows an agricultural and pastoral exploitation more intensive than today and an almost total absence of trees (Bazan et al. 2019).

Barley, though always in very low percentages, is present in the other Sicilian sites. Through the diachronic site of Monte Polizzo, it is very clear how Middle Age communities abandoned its use for human consumption (Stika, Heiss, and Zach 2008).

The cultivated landscape, therefore, was characterised in both Periods A and B by cereal farming, and the identification of a fair amount of legumes is an indicator of the practice of crop rotation. In both periods, a high diversification of legume varieties is maintained: most of it is *Vicia faba* var. *major* (the modern fava bean), *Vicia ervilia* (ervil), *Cicer arietinum* (chickpea), *Pisum sativum* (pea), *Lens culinaris* (lentil), and some fragments of unidentified large leguminous plants. The fragments of *Vicia faba* seem to be attributable to the *major* variant, the modern broad bean, rather than to the field bean (*minor* variant). The significant difference between the two periods (Period A 13.34%; Period B 42.85%) can be seen in the increase of legumes. This data may be interpreted as the introduction of a more refined and complex rotation technique, but can also be connected to a more varied diet, and perhaps even new culinary habits that differ from those in Period A.

The human–environment interactions in Contrada Castro during the Early Middle Ages are further evident in the exploitation of wood resources. Holm

oak is the prevailing species exploited across Periods A and B, and according to the current geobotanical characteristics of the surrounding area, it is still prevalent, especially on the southwest slopes of Mt. Barraù (Bazan et al. 2020a). The widespread use of wood species at different stages of the holm oak vegetation series across the site clearly indicates the exploitation of the wide range of this series for silviculture (Bazan et al. 2020b). If on the one hand holm oak is the prevailing wood resource across Periods A and B, on the other hand we note in Period B the absence of charcoals of downy oak, wild service tree, and manna ash, which are all common and frequent species in the downy woods of present-day Monti Sicani. The disappearance of these three wood species in the anthracological sample opens up various hypotheses. It is possible that during Period B the distribution areas of downy oak forest, which are located in hilly areas with thick and deep soils and are very suitable for cultivation (Figure 9), were completely deforested to make more space for agricultural activities. It seems less likely that this absence was caused by voluntary selection, and no longer exploiting these types of wood, rather than to a real absence or drastic decrease in these species in the surrounding plant landscape of the 10th–11th c. AD. This hypothesis seems to fit a more intensive agricultural exploitation,

as indicated by the high variety of cultivated species recorded in the carpological dataset for the 10th–11th c. AD.

The potentially cultivated species represent a very low percentage, consisting of Rosaceae Prunoideae. For this reason, it is possible to hypothesise on the exploitation of their wild species, which are naturally present in the area in the present-day as well; the discovery of fragments of prune endocarps in Period A, however, could suggest not only the presence of more varieties of Rosaceae Prunoideae, but also the sporadic exploitation of wild fruits.

The site of Contrada Castro is well-placed in the context of known medieval sites, as regards the high exploitation of wild wood species; although the absence of the olive tree and the low percentage of cultivated species deviates from sites in Rocchicella and Segesta, and on the other hand seems very similar to exploitation identified in Brucato. The existing analyses of wood charcoal in medieval contexts focus on the sites of Segesta (Castiglioni and Rottoli 1997), Brucato (Sciara) (Bossard-Beck 1984), and Rocchicella (Castiglioni 2008). Palynological analyses were carried out at the site of Piazza Armerina, in its Arab-Norman phase (Terranova et al. 2009; Montecchi and Mercuri 2016). In the 12th c. AD village of Segesta, wood charcoal analysis made it possible to identify the presence of over 20 taxa belonging to different vegetation belts: the first was characterised by broad-leaved evergreen trees (in particular *Oleo-Ceratonion*); there were also *Quercus suber* woods, characteristic of the hilly landscape and associated with bush formations, and some mountain environment species, which are certainly not found in the proximity of the site. The exploitation of tree resources in Brucato was very different: there were numerous conifers, oaks, beeches, willows, ash trees, poplars, and elms. The record from the Rocchicella site's high and low medieval phases showed the presence of evergreen oak, deciduous oak, olive, and green olive tree. From the Piazza Armerina data it was possible to outline the coeval landscape of this settlement – a hillside near a watercourse, characterised by pastures, olive groves, and cereal fields. The authors highlight a distinction between a phase in the 10th–11th c. AD, characterised by extensive arboreal coverage, both in terms of olive groves and woods in general, while in the middle of the Norman period (12th c. AD) the pastures extended and tree cover decreased; these changes can be attributed both to a different use of the land and to climatic variations.

The zooarchaeological data at Contrada Castro suggest a strategy of exploiting animal resources exclusively based on livestock, and this would seem to be the effect of a well-structured and organised rural economy across Periods A and B.

The recorded taxonomic overlap between Periods A and B in this study seems to be indicative of a

certain degree of continuity in the exploitation of animal resources over time. This could be connected to the maintenance of similar husbandry strategies as well – the archaeobotanical data that did not show for example the introduction of new species or a radical innovation between the two periods.

The presence of pigs in contexts of the Islamic period (10th–11th c. AD) shows evidence of this continuity. The presence/absence of pig remains is one of the crucial indicators used in evaluating the Islamisation of medieval societies. However, it should be consciously used, taking into consideration the administrative, economic, and cultural complexity that characterised the multifaceted social reality of Islamic Sicily. Indeed, recent zooarchaeological studies show the persistence of pork production in Sicilian rural sites during the Islamic period, also reporting a marked difference with the coeval urban realities where pigs' remains are almost absent (Arcoleo and Sineo 2014; Carver et al. 2018, 2019). Therefore, the consumption of pork recorded at Contrada Castro could be connected with the presence of a Christian community, and also with the difficulties of the Islamic legal and administrative apparatus in controlling its capillary of rural and peripheral territories in terms of enforcing religious taboos.

Based on traces left on bones, we can propose a butchery process aimed at producing small portions of meat, well suited to the preparation of boiled meats or stews. Although this dietary reconstruction fits well with the high number of cookware (jars and pots) recovered at the site (Castrorao Barba et al. 2020), it is necessary to acknowledge that the pervasive taphonomic bias, separate from human activity, could also have produced this distribution of body parts. Indeed, the main factor of uncertainty for this reconstruction lies in the above-mentioned destructive pressure of dogs. In fact, considering the relative distribution of the ratio between the observed and expected elements (Figure 8B), we can see that body parts that have a lower presence of spongy, cancellous bone (e.g. the distal humerus and proximal radius) are often over-represented, while those richer in cancellous bone, which will certainly have undergone greater destruction by dogs, are under-represented in the elements recovered at the site.

Although there exists sufficient evidence of a husbandry practice mostly addressed to meat exploitation, it is not possible to provide further information about the presence of a possible meat trading network involving Contrada Castro. The body parts distribution and butchery patterns here recorded are more informative in terms of intrasite consumption rather than meat production and distribution. Furthermore, the lack of zooarchaeological studies in the neighbouring urban site does not allow the gathering of fundamental elements capable of providing basic market

economy assessment as the extent of the urban demand cannot be estimated.

Cattle herding management would also seem to be congruent with the aforementioned model connected to meat exploitation, although the high occurrence of juvenile and young adult individuals does not exclude the consideration of strategy oriented towards dairy production. Indeed, the culling patterns connected to dairy herd management are not unique, and are influenced by various factors which are not always archaeologically visible, such as the dimensions of the herd; the male/female ratio; and even the motivation of the herder who can decide whether to cull a single individual based on its productivity. Although we cannot at present suggest a conclusive explanation on the nature of cattle husbandry, we can exclude the primary use of the *Bos taurus* as a draught animal during the 10th–11th c. AD at Contrada Castro. The complete absence of palaeopathological stress markers on cattle bones (e.g. joint diseases and osteoarthritis) and the high frequency of donkey remains would seem to highlight the latter's main role as a working animal.

## Conclusions

This research integrated anthracological, carpological, and zooarchaeological data to study an early medieval rural context inland of the Sicani Mountains, and this allows us to propose some considerations for the economic dynamics between the late 8th and 11th c. AD.

A first vital element lies in the close correlation between the geobotanical characteristics of the landscape of the Sicani Mountains and its suitability for certain practices. In fact, agriculture in the area is characterised by the cultivation of cereals as part of a rotation system with legumes, which adapt well to the pedoclimatic characteristics of this hilly area. The presence of a carbonate mountain system with steep slopes characterised by the holm oak vegetation series is reflected well in the anthracological data, which demonstrate the exploitation of holm oak as the main resource of forestry. The zooarchaeological analyses point toward herding management systems characterised by a certain degree of complexity. Although it is not possible to provide conclusive data aimed at revealing the role of the site within the broader market economy system, it is possible to exclude an animal exploitation pattern that only addressed the exigences of mere subsistence. Indeed, our results highlight simple but effective animal husbandry practice that mostly aimed at obtaining a good yield for the local community, but which also addressed the extra site economic exploitation of the surplus. Despite some changes observed between the two periods – the disappearance of the use of downy oak, wild service tree, and manna ash from Period A

to Period B; the increase in the percentage of legumes; and perhaps a small change in the strategies of culling caprine species – the transition between these periods does not show a radical and revolutionary change which may have been expected considering a deterministic association between political macro-events (e.g. the long Byzantine–Islamic conflict and the subsequent Islamic conquest of Sicily) and the economic and social dynamics visible in the archaeological data relating to the rural community of Contrada Castro.

## Acknowledgments

This study was supported by funds provided by Bona Furtuna LLC.

Angelo Castrorao Barba thanks the Spanish MINECO for the Juan de la Cierva-Incorporación research fellowship (IJCI-2017-31494).

The archaeological excavation has been carried out under the scientific direction of the 'Soprintendenza BB.CC.AA' of Palermo thanks to the support of Stefano Vassallo and Lucina Gandolfo.

## Disclosure Statement

No potential conflict of interest was reported by the author(s).

## Funding

This work was supported by the 'Harvesting Memories: Ecology and Archaeology of Monti Sicani landscapes (Central-Western Sicily)' project, funded by Bona Furtuna LLC; Ministerio de Ciencia, Innovación y Universidades.

## Notes on contributors

**Angelo Castrorao Barba** (PhD 2013 in Medieval Archaeology, University of Siena) is a post-doc fellow (2019–2021) at the Consejo Superior de Investigaciones Científicas (CSIC), Escuela de Estudios Árabes (EEA), Granada (Spain). His research focuses on rural settlement patterns from the Roman period to Late Antiquity and the Early Middle Ages in the Mediterranean area and in Sicily between Byzantine and Islamic period. In 2014–2015 he was a guest researcher at VU University Amsterdam and a postdoctoral fellow at the Royal Netherlands Institute in Rome (KNIR). In 2018 he was a postdoctoral fellow at the DFG Center for Advanced Studies 'Migration and Mobility in Late Antiquity and the Early Middle Ages' of the University of Tübingen. Between 2016 and 2018, he was research fellow on the project "Harvesting Memories: Ecology and Archaeology of Monti Sicani landscapes (Central-Western Sicily)" (University of Palermo). For the period 2018/2020 he is a postdoctoral scholar in the Getty-sponsored workshop series "Mediterranean Palimpsests". Email: castroraobarba@ee.csic.es.

**Claudia Speciale** (Ph.D. 2018 in Sciences of Cultural Heritage, University of Salento), Post-Doc researcher at the National Institute of Geophysics and Volcanology, Naples (Italy), she is responsible of paleoenvironmental



reconstructions for the project Brains2Islands. Her research focuses on island archaeology, prehistoric archaeobotany and paleoenvironment in Sicily. Her Ph.D. thesis was focused on paleodemography and use of archaeobotanical data for the evaluation of human subsistence systems on the Aeolian islands. She leads the research on the first human occupation of Ustica island (Sicily) and she performed the archaeobotanical analyses of more than 20 sites from Paleolithic to Middle Ages. Email: claudia.speciale@ingv.it.

**Roberto Micciché** is an osteoarchaeologist and registered forensic anthropologist at the Court of Palermo. He has a B.A. in Archaeology and Master in Forensic Science from the University of Palermo. From the 2012 is Research Fellow in Anthropology at the Laboratory of Anthropology and Forensic Scientific Applications of the STEBICEF Department, University of Palermo. From the 2018 Roberto is Courtesy Visiting Adjunct Professor at the Department of History of the University of South Florida. As archaeologist and osteoarchaeologist, Roberto has more of fifteen years of professional field experience and is involved in numerous archaeological projects based in Sicily in collaboration with different academic institutions. Email: robertomaria.micciche@unipa.it.

**Filippo Pisciotta** (MA 2014 in Archaeology, University of Palermo) is Ph.D. candidate in Late Antique Archaeology at Aix-Marseille University. He is specialist in Late Roman and Medieval pottery and trade in Sicily and also in photogrammetric methods applied in archaeological excavations and heritage. Email: filippo.pisciotta78@gmail.com.

**Carla Aleo Nero** (Post MA 1999 in Classical Archaeology, University of Catania) Officer for the Archaeological service in Palermo of the Sicilian Heritage Office (Soprintendenza BB.CC.AA.). She is specialised in urban archaeology of Palermo and pottery studies. Email: aleoneroca@gmail.com.

**Pasquale Marino** (Ph.D. 2011 in Environmental Sciences, University of Catania; Ph.D. 2013 in Plant biodiversity and landscape ecology, University of Palermo) President and COO at Bona Furtuna LLC (100% organic bio-farm) and researcher specialised in botany regarding flora, vegetation dynamics and biodiversity. Email: marino@bonafurtuna.com.

**Giuseppe Bazan** (Ph.D. 2003 in Botany, University of Palermo) Professor of Environmental and applied Botany at University of Palermo. His research focuses on landscape ecology and, as a botanist, his principal interest is in the role plant communities play in understanding the formative processes of the land mosaic. By combining field studies on plant biodiversity and G.I.S. techniques, his research addresses many complex aspects of landscape at both spatial and temporal scales. His laboratory also explores the world of plants from a cultural perspective, carrying out research both in archaeobotany and ethnobotany. He is scientific coordinator of the "Harvesting Memories" project. Email: giuseppe.bazan@unipa.it.

## ORCID

Angelo Castorao Barba  <http://orcid.org/0000-0002-4360-4328>

Claudia Speciale  <http://orcid.org/0000-0003-1527-9000>

Roberto Micciché  <http://orcid.org/0000-0002-2485-2019>

Pasquale Marino  <http://orcid.org/0000-0002-7624-4955>

Giuseppe Bazan  <http://orcid.org/0000-0002-4827-9579>

## References

- Arcifa, L. 2010. "Indicatori archeologici per l'alto Medioevo nella Sicilia orientale." In *Piazza Armerina. Villa del Casale e la Sicilia tra tardoantico e medioevo*, edited by P. Pensabene, 105–128. Roma: L'Erma di Bretschneider.
- Arcifa, L. 2016. "Rocchicella di Mineo: il sito tra età proto bizantina ed età tematica." In *Dopo l'antico. Ricerche di archeologia Medievale*, edited by L. Arcifa, and L. Maniscalco, 17–28. Catania: Assessorato Beni Culturali e Identità Siciliana.
- Arcifa, L. 2018. "Insularità siciliana e Mediterraneo altomedievale. Dati archeologici e quadri territoriali tra VIII e IX secolo." In *Southern Italy as Contact Area and Border Region during the Early Middle Ages. Religious-Cultural Heterogeneity and Competing Powers in Local, Transregional and Universal Dimensions*, edited by K. Wolf, and K. Herbers, 125–148. Köln Weimar Wien: Böhlau Verlag.
- Arcoleo, L., and L. Sineo. 2014. "Analisi Archeozoologica di Due Contesti della Città Antica di Palermo: La Gancia e i 'Sili' di Via Imera (Palermo, IX–X Secolo d.C.)." In *Les dynamiques de l'islamisation en Méditerranée centrale et en Sicile: nouvelles propositions et découvertes récentes*, edited by A. Nef, and F. Ardizzone, 301–306. Roma-Bari: Edipuglia.
- Asouti, E., C. Kabukcu, C. E. White, I. Kuijt, B. Finlayson, and C. Makarewicz. 2015. "Early Holocene Woodland Vegetation and Human Impacts in the Arid Zone of the Southern Levant." *The Holocene* 25: 10. doi:10.1177/0959683615580199.
- Barone, R. 1976. *Anatomie comparée des mammifères domestiques. Tome 1, Osteologie*. Paris: Atlas. Vigot frères.
- Bazan, G., A. Castorao Barba, A. Rotolo, and P. Marino. 2019. "Geobotanical Approach to Detect Land-Use Change of a Mediterranean Landscape: A Case Study in Central-Western Sicily." *GeoJournal* 84 (3): 795–811. doi:10.1007/s10708-018-9892-1.
- Bazan, G., A. Castorao Barba, A. Rotolo, and P. Marino. 2020a. "Vegetation Series as a Marker of Interactions between Rural Settlements and Landscape: New Insights from the Archaeological Record in Western Sicily." *Landscape Research* 45 (4): 484–502. doi:10.1080/01426397.2020.1730774.
- Bazan, G., P. Marino, R. Guarino, G. Domina, and R. Schicchi. 2015. "Bioclimatology and Vegetation Series in Sicily: A Geostatistical Approach." *Annales Botanici Fennici* 52 (1–2): 1–18. doi:10.5735/085.052.0202.
- Bazan, G., C. Speciale, A. Castorao Barba, S. Cambria, R. Micciché, and P. Marino. 2020b. "Historical Suitability and Sustainability of Sicani Mountains Landscape (Western Sicily): An Integrated Approach of Phytosociology and Archaeobotany." *Sustainability* 12 (8): 3201. doi:10.3390/su12083201.
- Beolchini, V., G. Mandatori, M. Moreno García, L. Peña-Chocarro, G. Pérez-Jordà, and J. Russo. 2018. "Economia, commerci e consumi in area tuscolana, alla luce della cultura materiale." In *VIII Congresso Nazionale di Archeologia Medievale, Volume 2, Sezione III Territorio e Paesaggio*, edited by F. Sogliani, B. Gargiulo, E. Annunziata, and V. Vitale, 309–312. Firenze: All'Insegna del Giglio.
- Boessneck, J. 1970. "Osteological Differences Between Sheep (*Ovis aries* Linné) and Goats (*Capra hircus* Linné)." In *Science in Archaeology*, edited by D. Brothwell, and E. Higgs, 331–358. New York: Praeger.

- Bossard-Beck, C. 1984. "Le mobilier ostéologique et botanique." In *Brucato. Histoire et archéologie d'un habitat médiévale en Sicile, vol.2*, edited by J. M. Pesez, 615–671. Rome.
- Cambini, A. 1967. "Riconoscimento microscopico del legno delle querce italiane." In *Contributi scientifico-pratici per una migliore conoscenza del legno*, 10, edited by G. Giordano, 51–80. Roma: C.N.R.
- Cappers, R. T. J. 2018. *Digital Atlas of Traditional Food Made from Cereals and Milk*. Groningen: Barkhuis and Groningen University Library.
- Cappers, R. T. J., and R. Neef. 2012. *Handbook of Plant Palaeoecology*. Groningen: Barkhuis and Groningen University Library.
- Cappers, R. T. J., and R. Neef. 2016. *Digital Atlas of Traditional Agricultural Practises and Food Processing*. Groningen: Barkhuis and Groningen University Library.
- Carver, M. O. H., and A. Molinari. 2016. "Sicily in Transition Research Project: Investigations at Castronovo di Sicilia. Results and Prospects 2015." *FOLD&R FastiOnLine Documents & Research* 352: 1–12.
- Carver, M. O. H., A. Molinari, V. Aniceti, C. Capelli, F. Colangeli, L. Drieu, G. Fiorentino, et al. 2019. "Sicily in Transition: New Research on Early Medieval Sicily, 2017–2018." *FOLD&R FastiOnLine Documents & Research* 437: 1–35.
- Carver, M. O. H., A. Molinari, V. Aniceti, F. Colangeli, N. Giannini, F. Giovannini, M. Hummler, C. Mangiaracina, A. Meo, and P. Orecchioni. 2018. "Sicily in Transition: Interim Report of Investigations at Castronovo di Sicilia 2016." *FOLD&R FastiOnLine Documents & Research* 412: 1–25.
- Castiglioni, E. 2008. "I resti botanici." In *Il Santuario dei Palici. Un centro di culto nella valle del Margi*, edited by L. Maniscalco, 365–386. Palermo: Regione Siciliana.
- Castiglioni, E., and M. Rottoli. 1997. "I macroresti vegetali." In *Segesta II. Il Castello e la Moschea. Scavi 1989–1995*, edited by A. Molinari, 235–257. Palermo: Flaccovio editore.
- Castrorao Barba, A. 2015. "Entroterra tra due mari: il territorio di Castronovo di Sicilia (Palermo) tra età romana e periodo bizantino." In *Storia e archeologia globale 2. I pascoli, i campi, il mare. Paesaggi d'altura e di pianura in Italia dall'Età del Bronzo al Medioevo*, edited by F. Cambi, G. De Venuto, and R. Goffredo, 253–267. Bari: Edipuglia.
- Castrorao Barba, A. 2016. "Sicily before the Muslims. The Transformation of the Roman Villas Between Late Antiquity and the Early Middle Ages, Fourth to Eighth Centuries CE." *Journal of Transcultural Medieval Studies* 3 (1-2): 145–189. doi:10.1515/jtms-2016-0005.
- Castrorao Barba, A., R. Micciché, F. Pisciotta, P. Marino, G. Bazan, C. Aleo Nero, and S. Vassallo. 2018b. "Archeologia nel territorio dei Monti Sicani (Harvesting Memories Project). L'insediamento di lunga durata di Contrada Castro (Corleone, Palermo). Prima campagna di scavo 2017." *FOLD&R the Journal of Fasti Online* 416: 1–21.
- Castrorao Barba, A., R. Micciché, F. Pisciotta, P. Marino, G. Bazan, C. Aleo Nero, and S. Vassallo. 2018c. "Un nuovo insediamento rurale nel territorio dei Monti Sicani tra epoca bizantina e normanna: dati preliminari sul sito di lunga durata di Contrada Castro (Corleone, PA)." In *VIII Congresso Nazionale di Archeologia Medievale, Volume 2, Sezione III Territorio e Paesaggio*, edited by F. Sogliani, B. Gargiulo, E. Annunziata, and V. Vitale, 254–258. Firenze: All'Insegna del Giglio.
- Castrorao Barba, A., R. Micciché, F. Pisciotta, C. Speciale, C. Aleo Nero, S. Vassallo, P. Marino, and G. Bazan. 2020. "Nuovi dati sull'occupazione altomedievale dell'insediamento di Contrada Castro (Corleone, Palermo) nell'area dei Monti Sicani." *FOLD&R the Journal of Fasti Online* 468: 1–15.
- Castrorao Barba, A., A. Rotolo, G. Bazan, P. Marino, and S. Vassallo. 2017. "Long-term Human Occupation of a Rural Landscape in Central-Western Sicily (Castro/Giardinello Valley and Mt Barraù): Harvesting Memories Project Case Study." *ArkeoGazte. Revista de arqueología – Arkelogia aldizkaria* 7: 175–192.
- Castrorao Barba, A., A. Rotolo, G. Bazan, P. Marino, and S. Vassallo. 2018a. "The Harvesting Memories Project: Landscape Archaeology in the Castro/Giardinello Valley and Mt. Barraù (Corleone, Palermo)." In *Studi in memoria di Fabiola Ardizzone 2, Scavi, Topografia e Archeologia del paesaggio*, edited by R. M. Carra, and E. Vitale, 53–78. Palermo: Antipodes.
- Chabal, L. 1994. "Apports récents de l'anthracologie a la connaissance des paysages passés: performances et limites." *Histoire & Mesure* 9 (3–4): 317–338.
- Costantini, L., and L. Costantini Biasini. 2010. "Archaeobotany." In *The Chora of Croton: v. 1: The Neolithic Settlement at Capo Alfiere*, edited by J. Morter, 175–189. Austin: University of Texas Press.
- D'Alpoim Guedes, J., and R. Spengler. 2015. "Sampling Strategies in Paleoethnobotanical Analysis." In *Method and Theory in Paleoethnobotany*, edited by J. M. Marston, J. d'Alpoim Guedes, and C. Warinner, 77–94. Boulder: University of Colorado Press.
- Davis-Secord, S. 2017. *Where Three Worlds Met: Sicily in the Early Medieval Mediterranean*. Ithaca: Cornell University Press.
- Decker, M. 2009. "Plants and Progress: Rethinking the Islamic Agricultural Revolution." *Journal of World History* 20 (2): 187–206. doi:10.1353/jwh.0.0058.
- Dobney, K., and K. Rielly. 1988. "A Method for Recording Archaeological Bones: The Use of Diagnostic Zones." *Circaea* 5 (2): 79–96.
- Gianguzzi, L., and G. Bazan. 2019. "The Olea europaea L. var. sylvestris (Mill.) Lehr. forests in the Mediterranean Area." *Plant Sociology* 56 (2): 3–34. doi:10.7338/pls2019562/01.
- Gianguzzi, L., and G. Bazan. 2020. "A Phytosociological Analysis of the Olea europaea L. var. sylvestris (Mill.) Lehr. forests in Sicily." *Plant Biosystems* 154 (5): 705–725. doi:10.1080/11263504.2019.1681532.
- Grant, A. 1982. "The Use of Tooth Wear as a Guide to the Age of Domestic Ungulates." In *Ageing and Sexing Animal Bone from Archaeological Sites*, edited by Bob Wilson, Caroline Grigson, and Sebastian Payne, 91–108. Oxford: BAR Brit Ser 109.
- Grayson, D. 1978. "Minimum Numbers and Sample Size Invertebrate Faunal Analysis." *American Antiquity* 43: 53–65.
- Habermehl, K. H. 1975. *Die Altersbestimmung bei Haus und Labortieren 2. Vollständig neubearbeitete Auflage*. Berlin and Hamburg: Paul Parey.
- Hanot, P., and C. Bochaton. 2018. "New Osteological Criteria for the Identification of Domestic Horses, Donkeys and their Hybrids in Archaeological Contexts." *Journal of Archaeological Science* 94: 12–20. doi:10.1016/j.jas.2018.03.012.

- Lentjes, D. 2016. *Landscape and Land Use in First Millennium BC Southeast Italy: Planting the Seeds of Change*. Amsterdam: Amsterdam University Press.
- Mercuri, A. M., M. C. Montecchi, A. Florenzano, E. Rattighieri, P. Torri, D. Dallai, and E. Vaccaro. 2019. "The Late Antique Plant Landscape in Sicily: Pollen from the Agro-Pastoral Villa del Casale-Philosophiana System." *Quaternary International* 499: 24–34. doi:10.1016/j.quaint.2017.09.036.
- Molinari, A. 2015. "Islamisation' and the Rural World: Sicily and al-Andalus. What Kind of Archaeology?" In *New Directions in Early Medieval European Archaeology: Spain and Italy Compared Essays for Riccardo Francovich*, edited by H. R. Gelichi Sauro, 187–221. Turnhout: Brepols Publishers.
- Molinari, A. 2016. "Fortified and Unfortified Settlements in Byzantine and Islamic Sicily: 6th to 11th Centuries." In *Fortified Settlement in Early Medieval Europe: Defended Communities of the 8th–10th Centuries*, edited by H. H. Christie, 320–332. Oxford: Oxbow.
- Molinari, A. 2019. "Sicily from Late Antiquity to Early Middle Ages: Resilience and Disruption." In *Change and Resilience: The Occupation of Mediterranean Islands in Late Antiquity*, edited by C. M. F. M. Cau Ontiveros, 87–110. Oxford: Oxbow books.
- Montecchi, M. C., and A. M. Mercuri. 2016. "When Palynology Meets Classical Archaeology: The Roman and Medieval Landscapes at the Villa del Casale di Piazza Armerina, UNESCO Site in Sicily." *Archaeological and Anthropological Sciences* 10: 743–757. doi:10.1007/s12520-016-0442-9.
- Nardi-Berti, R. 2006. *La struttura anatomica del legno ed il riconoscimento dei legnami italiani di più corrente impiego*. Firenze: IRL-CNR, II edizione.
- Nef, A., L. Arcifa, and A. Bagnera. 2012. "Archeologia della Sicilia islamica: nuove proposte di riflessione." In *Villa 4 Histoire et archéologie de l'Occident musulman (VIIe-XVe siècle): al-Andalus, Maghreb, Sicile, Université Toulouse-Le Mirail*, edited by Philippe Sénac, 241–274. Toulouse: Colección Méridiennes, Serie de «Études Médiévales Ibériques».
- O'Connor, T. 2000. *The archaeology of Animal Bones*. Stroud (Glos.): Sutton Publishing Ltd.
- Payne, S. 1973. "Kill-Off Patterns in Sheep and Goats: The Mandibles from Aşvan Kale." *Anatolian Studies* 23: 281–303.
- Pensabene, P., and P. Barresi. 2019. *Piazza Armerina. Villa del Casale: scavi e studi nel decennio 2004–2014*. Roma: L'Erma di Bretschneider.
- Prigent, V., and A. Nef. 2006. "Per una nuova storia dell'alto medioevo siciliano." *Storica* 35-36 (XII): 1–55. doi:10.1400/91697.
- Rizzo, M. S. 2014. "Agrigento ed il suo territorio in età tar-doantica e bizantina: primi dati da recenti ricerche." *Sicilia antiqua: International Journal of Archaeology* 11: 399–418.
- Rowley-Conwy, P., U. Albarella, and K. Dobney. 2012. "Distinguishing Wild Boar from Domestic Pigs in Prehistory: A Review of Approaches and Recent Results." *Journal of World Prehistory* 25: 1–44.
- Salvagno, L., and U. Albarella. 2017. "A Morphometric System to Distinguish Sheep and Goat Postcranial Bones." *Plos One* 12 (6): e0178543. doi:10.1371/journal.pone.0178543.
- Schweingruber, F. H. 1990. *Anatomy of European Wood: An Atlas for the Identification of European Trees, Shrubs and Dwarf Shrubs*. Bern: Paul Haupt.
- Silver, I. A. 1969. "The Aging of Domestic Animals." In *Science in Archaeology*, edited by D. Brothwell, and E. Higgs, 283–299. London: Thames & Hudson.
- Stika, H. P., A. G. Heiss, and B. Zach. 2008. "Plant Remains from the Early Iron Age in Western Sicily: Differences in Subsistence Strategies of Greek and Elymian Sites." *Vegetation History and Archaeobotany* 17: 139–148. doi:10.1007/s00334-008-0171-9.
- Terranova, F., C. A. Accorsi, M. Bandini Mazzanti, A. M. Mercuri, P. Torri, E. Manicardi, M. C. Montecchi, et al. 2009. "Indagini archeopalinologiche in Sicilia a Taormina, Piazza Armerina e Mozia." In *Diagnostica e Conservazione. Esperienze e proposte per una carta del rischio*, edited by Assessorato BB.CC.AA. e P.I., 284–296. Atti del III convegno internazionale di studi "La materia e i segni della storia" (Palermo, 2007). Palermo: Regione siciliana.
- Thery-Parisot, I., L. Chabal, and J. Chravzev. 2010. "Anthracology and Taphonomy, from Wood Gathering to Charcoal Analysis. A Review of the Taphonomic Processes Modifying Charcoal Assemblages, in Archaeological Contexts." *Palaeogeography, Palaeoclimatology, Palaeoecology* 291 (1–2): 142–153. doi:10.1016/j.palaeo.2009.09.016.
- Vaccaro, E. 2017. "Philosophiana in Central Sicily in the Late Roman and Byzantine Periods: Settlement and Economy." In *Encounters, Excavations and Argosies: Essays for Richard Hodges*, edited by J. Mitchell, J. Moreland, B. Leal, and R. Hodges, 300–313. Oxford: Archaeopress.
- Vassallo, S. 2009. "Le fortificazioni bizantine del Kassari di Castronovo di Sicilia: indagini preliminari." In *Immagine e immagini della Sicilia e di altre isole del Mediterraneo antico*, 2, edited by C. Ampolo, 679–696. Pisa: Edizioni della Normale.
- von den Driesch, A. 1976. *A Guide to the Measurement of Archaeological Bones from Archaeological Sites*. Cambridge, MA: Peabody Museum Bulletin 1.
- White, T. 1953. "A Method of Calculating the Dietary Percentage of Various Food Animals Utilized by Aboriginal Peoples." *American Antiquity* 18: 396–398.
- Zeder, M., and H. Lapham. 2010. "Assessing the Reliability of Criteria Used to Identify Postcranial Bones in Sheep, Ovis, and Goats, *Capra*." *Journal of Archaeological Science* 37: 2887–2905. doi:10.1016/j.jas.2010.06.032.
- Zeder, M. A., and S. E. Pilaar. 2010. "Assessing the Reliability of Criteria Used to Identify Mandibles and Mandibular Teeth in Sheep, Ovis, and Goats, *Capra*." *Journal of Archaeological Science* 37: 225–242. doi:10.1016/j.jas.2009.10.002.