

# The impact of Roman conquest on the pattern of livestock exploitation on the Balearic Islands

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**ABSTRACT:** The conquest of the Eastern Balearic Islands by the Romans produced a profound transformation of the native communities and of their economic system. Whereas several aspects of the local economy at that period are well known, the changes experienced in the patterns of production and consumption of livestock still remain to be deciphered. By studying a series of faunal remains from the two main islands (*i.e.*, Mallorca and Menorca), and focusing on the period spanning from the Iron Age to the Roman transition, we have approached the changes experienced in animal husbandry. Data from a large number of sites from both islands reveal the changes experienced in species composition and body size.

**KEYWORDS:** IRON AGE – ROMAN TRANSITION, ANIMAL HUSBANDRY, BALEARIC ISLANDS, SPECIES REPRESENTATION, BODY SIZE

**RESUMEN:** La conquista de las islas baleáricas orientales por los romanos dio lugar a una profunda transformación de las comunidades indígenas y de su sistema económico. Si bien se conocen algunos aspectos económicos de esa fase, todavía no está bien definidos los cambios que se experimentaron en los modelos de producción y consumo de la cabaña ganadera. Mediante el estudio de los restos faunísticos de las dos islas (Mallorca y Menorca), y centrándonos en la transición entre la Edad del Hierro y la época romana, conseguimos precisar mejor estos aspectos. Se utilizan los datos de una serie de yacimientos ponen de manifiesto los cambios experimentados en la presencia de las distintas especies así como en sus tallas.

**PALABRAS CLAVE:** TRANSICIÓN EDAD DEL HIERRO – ÉPOCA ROMANA, GANADERÍA, ISLAS BALEARES, REPRESENTATIVIDAD DE LAS ESPECIES, TALLA

## INTRODUCTION

In 123 AD, the consul *Quintus Caecilius Metellus* incorporated the Balearic Islands to the Roman Republic. The ultimate reasons underlying this conquest remain controversial (e.g., Morgan, 1969; Orfila & Arribas, 1997; Zucca, 1998), but were probably related to the strategic position of the Balearic Islands in the shipping lanes of the western Mediterranean. The Roman invasion triggered a series of profound changes in the socio-political structures of the islands (Orfila, 1988) and in their economic system. A large number of Roman colonists settled on the islands (Strabo III, 5.2), and the volume of overseas imported goods increased considerably (Zucca, 1998).

In Mallorca, the cities of *Palma* and *Pollentia* were founded as new administrative centres. Dividing the land into *centuriae* (Cardell & Orfila, 1992; Carlsen *et al.*, 1994), romans established a new territorial organization pursuing the maximal agricultural exploitation of the land (Orfila *et al.*, 1996). Archaeological research documents the presence of *villa*-type settlements on the island, such as those at Sa Mesquida (Vallespir *et al.*, 1987; Orfila *et al.*, 1996), Son Matet (Font *et al.*, 1995), Son Joan Jaume and Can Maiol (Orfila, 1993). In Menorca, the cities of *Iamo*, *Mago* and *Sanisera* were founded, although currently there is no evidence of settlements such as *villae* and *centuriae* on the countryside (Orfila, 1995). Despite these novel developments in land management, some pre-Roman features persisted. As attested in many areas of the islands, the former Iron Age settlements continued to be inhabited during the 1<sup>st</sup> century AD (Fernández-Miranda, 1983; Tarradell, 1983; Orfila & Sintes, 1984). In the countryside, native settlements were only slightly refurbished and remained as basic units of production (Coll *et al.*, 1984; Orfila *et al.*, 1996). Thus, the Roman colonization resulted in some homogenisation, but inter-island differences remained due to the persistence of native settlements and the differential implementation of new structures. Consequently, agriculture practices and animal husbandry implemented after the Roman colonization could differ between the two islands.

Former studies of faunal remains at Iron Age-Roman transition sites of many regions of Europe point to a widespread and marked increase in body size of livestock and to a coeval change in the mor-

tality curve of domestic species, although some exceptions exist (e.g., Teichert, 1984; Lauwerier, 1988; Lepetz, 1996; Albarella *et al.*, 2008). In a previous work, we already studied these changes on the island of Mallorca (Valenzuela *et al.*, 2013). Now, with an extended data-set of zooarchaeological material, we can provide a more detailed picture of the changes that took place on animal husbandry under Roman rule.

## MATERIALS AND METHODS

This paper will discuss zooarchaeological data from two islands –Mallorca and Menorca– and four periods: the Early Iron Age (900-500 BC), Late Iron Age (500-123 BC), Early Roman (123 BC – 1<sup>st</sup> c. AD) and Mid-Late Roman (2<sup>nd</sup>- 3<sup>th</sup> C. AD). The Iron Age division follows Lull *et al.* (1999, 2001), who established two periods: the Talaiotic (c. 850 – c. 550 BC) and the Post-Talaiotic (c. 550 – 123 BC). In this study, however, we use instead the terms Early Iron Age and Late Iron Age, respectively, in order to facilitate the comparison with other European areas. The Roman period is divided into two main phases following the stratigraphy of the different studied contexts.

All the zooarchaeological data available, whether of bibliographical sources or product of our own research, were analysed under this chronological framework. Our analysis is based on, approximately, 70,000 animal bone fragments belonging to the four most represented domestic animals: cattle, sheep, goat and pig (Table 1). In order to incorporate the maximum information from the bibliographic sources, sheep and goat were analysed combined to establish the % NISP (*i.e.*, Number of Identified Specimens), while were dealt separately to analyse body size trends. We excluded the remains of equids, deer, rabbits and other mammals from the analysis due to their reduced representation in the assemblages (< 5%).

We have analysed 19 Mallorcan and 6 Menorcan sites from the Iron Age and the Roman period (Figure 1). The majority of sites have been studied archaeologically and the results published, but we have also included unpublished zooarchaeological information. In some instances, the results of the excavations have not been published yet, so the origin of the materials cannot be accurately determined

Site	Date	% Sheep/ Goat	% Cattle	% Pig	NISP *	Reference
a) Mallorca						
Son Ferragut	Early Iron Age	70,1	25,4	4,5	308	Estévez & Montero, 2003
Son Fornés (total)	Early Iron Age	49,1	28,4	22,5	1745	Estévez, 1984a
Son Fornés (without Talaiots)	Early Iron Age	61,5	22,5	16	564	Estévez, 1984a
S'Illot	Early Iron Age	72,3	18,2	9,5	4685	Uerpman, 1971
Puig d'en Pau	Early Iron Age	69,6	22,3	8,1	355	Noguera 2001b Martínez & Aramburu- Zabala, 2012
Cascanar	Early Iron Age	79,9	8,8	11,3	648	Aramburu-Zabala, 2013
Can Sec	Early Iron Age	84,1	11,1	4,8	1466	Romero, 1971
Almallutx	Early Iron Age	65,4	16,2	18,2	ND	Ramis, 2005
Ses Païsses 99/00	Iron Age	72,7	17,7	9,6	3600	Chapman & Grant, 1995; 1997
Son Ferrandell	Iron Age	80,7	10,6	8,7	2499	Martínez & Aramburu- Zabala, 2012
Cascanar	Late Iron Age	86,8	5,6	7,6	334	Noguera, 2001a
Pou Celat	Late Iron Age	52,9	30	17,1	358	Uerpman, 1971
S'Illot	Late Iron Age	75,5	15,2	9,3	1809	Martínez, 2011
Ses Païsses E-14	Late Iron Age	86	7,9	6,1	1298	Iborra, 2005
Na Guardis	Late Iron Age	80,4	12,6	7	199	Hernández-Gasch et al., 2002; 2011
Punta des Patró	Late Iron Age	75	17,9	7,1	200	Nadal, 2000
Illot des Porros	Late Iron Age	59,8	29,5	10,5	1376	in this paper
Son Espases	2nd C. BC	9,9	80,3	9,8	17468	1st c. BC - 1st c. AD
Pollentia	AD	23,7	19,2	57,1	3557	in this paper
Pollentia	2nd- 3rd C. AD	37,5	31	31,5	5802	in this paper
b) Menorca						
Montefí	Early Iron Age	56,5	34,9	8,6	690	in this paper
Montefí	Late Iron Age	63,1	24,7	12,2	903	in this paper
Torre d'en Gaumés (Cartailhac)	Late Iron Age	64,8	14,6	20,6	1934	Tornero et al., 2011
Biniparratx petit	Late Iron Age	61,2	24,9	13,9	7601	Morales-Pérez, 2004
Talati de Dalt	Late Iron Age	58,4	21,3	20,3	2813	Morales-Pérez, 2005
ses Talaies d'en Alzina	Late Iron Age	44,8	40,7	14,5	1027	García, 2004
Montefí	1st- 3rd C. AD	43,4	41,3	15,3	3732	in this paper
Sanisera (Urban context)	Roman	56,5	15,7	27,8	665	Bagley, 2010
Sanisera (Roman camp)	Roman	49,8	36,1	14,1	1312	Bagley, 2009

\* NISP: only of the four species

ND: Number of identified specimens not specified in the report

TABLE 1

Percentages of sheep/goat, cattle and pig of the Iron Age and Roman sites of Mallorca and Menorca.

(Micó, 2005). In others, there was no good chronological control on some of the assemblages. Most of the samples were indirectly dated through pottery

associations since the stratigraphy of the sites has not been always clear-cut (e.g., Chapman & Grant, 1989).

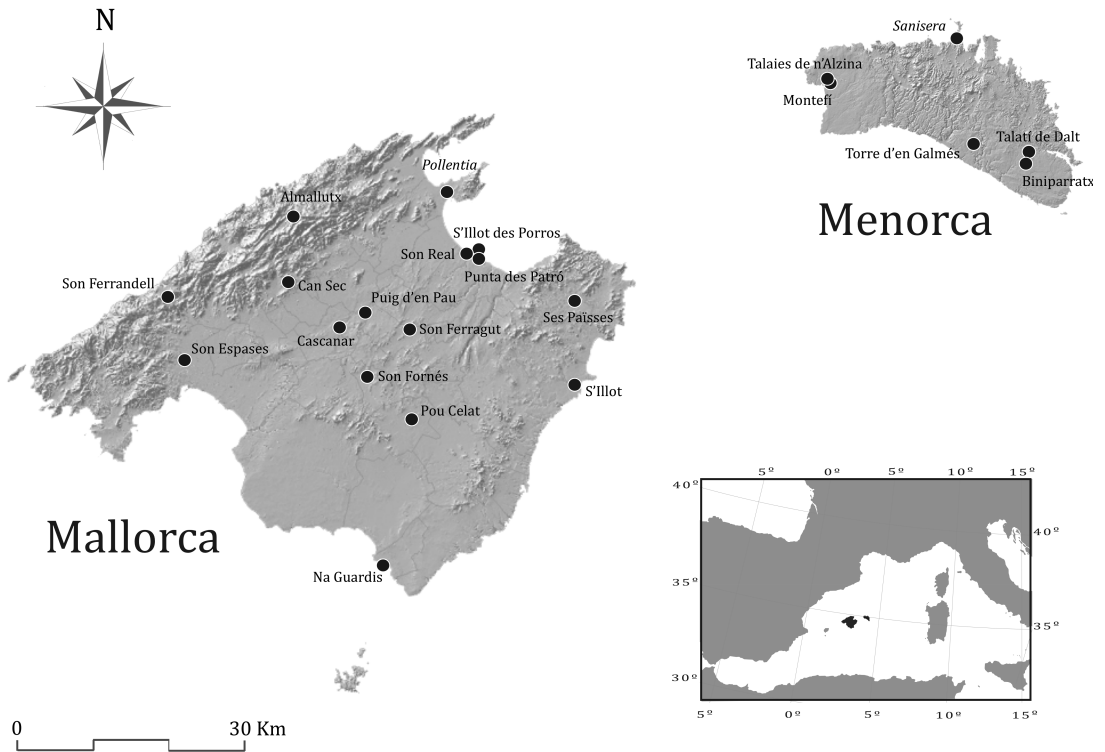


FIGURE 1

Location of the Balearic Islands and the different sites mentioned in the text.

Our study focuses on two aspects concerning four domestic taxa (*i.e.*, cattle, sheep, goat and pig): species representation and trends in body size. In order to analyse and compare the faunal assemblages, NISP was used (Lyman, 1994: 100). This is presented in faunal reports under various guises (*i.e.* “Number of Fragments”, “Number of bone remains”). The quantification method used in these reports allows us to assimilate the figures to the standard NISP. Additionally, in order to visualize changes in diet, the domestic mammals have been plotted (as % of NISP) onto a triangular graph, following King (1999).

Measurements follow the criteria of Driesch (1976). In our assemblages, some additional measurements were taken following the criteria of Davis (1992) and Payne and Bull (1988). In order to maximise the potential information of these data, the log

ratio technique of Simpson *et al.* (1960) was used to analyse the size variation in domesticates. This method uses the logarithm of the ratio between a measurement and a standard mean (*e.g.*, Meadow, 1999; Albarella, 2002). Although Davis (1996) suggests perform a separate analysis for the measurements taken along different axes (length, width or depth), here they are dealt together due to the scarcity of data. The standard used for the calculation of cattle log ratios was the mean of the measurements from Period II of Elms Farm (Johnstone & Albarella, 2002); for pigs, the mean of the sample of Late Neolithic Durrington Walls (Albarella & Payne, 2005); for caprines, the mean of the sample of unimproved Shetland ewes (Davis, 1996). Where relevant, the Mann-Whitney *U*-test was employed to determine the significance of observed biometrical differences.

## RESULTS

Table 1 provides a summary of the species representation in the assemblages studied on each island. On Mallorca, the average percentage of sheep and/or goat increases from 69% at the Early Iron Age to 73.8% at the Late Iron Age, whereas the percentages of cattle and pig show a decrease from 19.1% to 16.9% and from 11.8% to 9.2%, respectively. Despite all these changes, the relative representation of the three taxa seems not to vary considerably between the two periods (Figure 2). On Menorca, although limited by the small number of assemblages considered, the general trends are slightly different. The percentage of sheep/goat remains almost stable through time from 58.4% at the Early Iron Age to 56.5% at the Late Iron Age. Cattle show an increase from the Early to Late Iron Age from 25.2% to 34.9%. In an opposite way, pig shows a small decrease over time, passing from 16.3% at the Early Iron Age to 8.6% at the Late Iron Age.

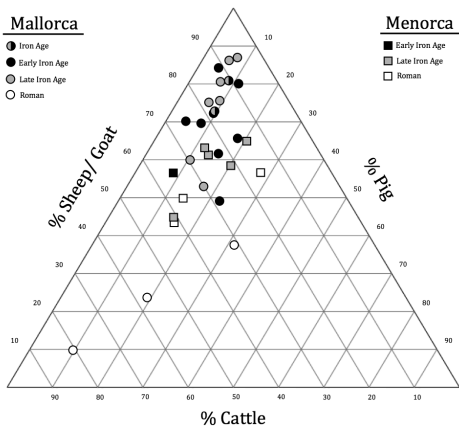


FIGURE 2

Ternary plot showing the relative proportions of cattle, sheep/goat and pig for the three periods at the different sites of Mallorca and Menorca.

Clearly, on both islands sheep and/or goats were the dominant species at all sites during the Early and Late Iron Age. The frequency of pig decreases from the Early to Late Iron Age. It seems to be just a slight difference between islands in species representation, with a higher percentage of cattle on Menorca.

With the arrival of the Romans, this pattern changes. Although the perspective is limited by the scarcity of sites, the frequencies between the domestic mammals obtained are now radically different to those from previous periods.

On Mallorca, at the Roman military camp of Son Espases, the predominance of cattle is overwhelming, reaching up to 80.3%. At the Roman city of *Pollentia*, pigs dominate at the levels of the Early Roman period, but later, in the Mid-Late Roman Period, there is a more equitable distribution of sheep/goat, pig and cattle.

On the island of Menorca, all Roman assemblages still show a predominance of sheep and goat bones. Their number decreased to an average frequency of 49.9%. In contrast, the frequency of cattle and pig slightly increased to 31% and 19.1%, respectively. Despite all these changes, the frequencies between species remain roughly similar to those of the previous period.

The results of the biometric analysis are presented per species and site. In Mallorca, the size of sheep bones remains unchanged throughout the Iron Age (Figure 3). Although there are minor differences between some sites, the main exception is found at Son Ferrandell. But the chrono-stratigraphical problems and inconsistencies around this site (Chapman & Grant, 1989) prevent us to consider these differences as significant. An abrupt change in size seems to have occurred at the last quarter of the 2<sup>nd</sup> C. AD. As shown in Table 2, the differences between pre-Roman sites and Son Espases or the Early Roman period of *Pollentia* are highly significant. This trend in size seems to reverse slightly at the 2<sup>nd</sup> and 3<sup>rd</sup> century AD levels of *Pollentia*.

In all the Menorcan Late Iron Age assemblages, domesticates are markedly larger than those of the Early Iron Age sample of Montefi. Furthermore the increased body size of domesticates stays throughout the Roman period, as derived from data of 1<sup>st</sup> - 3<sup>rd</sup> century AD levels of Montefi.

The situation seems to be different for goats (Figure 4). In Mallorca there are no practical differences in size until the Mid-Late Roman period, and then, only the bones from *Pollentia* are significantly larger than those from the remaining sites (Table 3). In Menorca, goats roughly follow the similar trend of sheep. Most of the Late Iron Age sites show an increase in body size. The exception is found at

Site	Period	Summary					Statistical difference between sites (p)							
		Min.	Max.	n	Mean	SD	I	II	III	IV	V	VI	VII	VIII
I Son Ferrandell	Iron Age	-0.15	0.03	85	-0.05	0.036		**	***	**	**	**	***	***
II Son Ferragut	Early Iron Age	-0.16	-0.01	38	-0.07	0.033			N	N	N	***	***	***
III S'Illot	Early Iron Age	-0.17	0.02	209	-0.08	0.039				N	*	***	***	***
IV Son Fornés	Early Iron Age	-0.15	0.06	73	-0.07	0.048					N	***	***	***
V S'Illot	Late Iron Age	-0.16	0.04	114	-0.07	0.042						***	***	***
VI Son Espases	2nd c. BC	-0.13	0.09	117	-0.04	0.038							***	***
VII Pollentia	1st c. BC- 1st c. AD	-0.04	0.14	115	0.05	0.031								***
VIII Pollentia	2nd - 3rd c. AD	-0.08	0.11	213	0.02	0.034								

Site	Period	Summary					Statistical difference between sites (p)					
		Min.	Max.	n	Mean	SD	I	II	III	IV	V	VI
I Montefí	Early Iron Age	-0.13	0.04	88	-0.07	0.038		***	***	***	***	***
II Montefí	Late Iron Age	-0.09	0.05	68	-0.03	0.035			***	***	***	***
III Biniparratx	Late Iron Age	-0.09	0.08	297	0.01	0.029				*	***	N
IV Talatí de Dalt	Late Iron Age	-0.06	0.07	42	0.00	0.034					N	N
V Cercle de Cartailhac	Late Iron Age	-0.10	0.08	196	0.00	0.032						***
VI Montefí	Roman	-0.09	0.10	437	0.01	0.220						

Results of Mann-Whitney U-test: N, not significant; \* significant at the 95% confidence interval; \*\* significant at the 99% confidence interval; \*\*\* significant at the 99.9% confidence interval

TABLE 2  
*Ovis aries*: summary table for log ratios measurements.

Site	Period	Summary					Statistical difference between sites (p)						
		Min.	Max.	n	Mean	SD	I	II	III	IV	V	VI	VII
I Son Ferragut	Early Iron Age	-0.13	0.14	5	0.01	0.083			N	N	N	N	N
II S'Illot	Early Iron Age	-0.13	0.14	106	0.00	0.058				N	N	*	***
III Son Fornés	Early Iron Age	-0.10	-0.13	46	0.01	0.057				N	N	N	***
IV S'Illot	Late Iron Age	-0.09	0.14	70	0.00	0.059					N	N	***
V Son Espases	2nd c. BC	-0.07	0.09	26	0.00	0.043						*	***
VI Pollentia	1st c. BC- 1st c. AD	-0.05	0.08	33	0.02	0.031							***
VII Pollentia	2nd - 3rd c. AD	-0.04	0.16	201	0.06	0.035							***

Site	Period	Summary					Statistical difference between sites (p)						
		Min.	Max.	n	Mean	SD	I	II	III	IV	V	VI	
I Montefí	Early Iron Age	-0.07	0.06	22	-0.01	0.032				N	*	*	**
II Montefí	Late Iron Age	-0.04	0.02	3	-0.01	0.030							
III Biniparratx	Late Iron Age	-0.10	0.10	236	0.00	0.035					*	*	***
IV Talatí de Dalt	Late Iron Age	-0.04	0.10	19	0.02	0.037						N	N
V Cercle de Cartailhac	Late Iron Age	-0.06	0.12	43	0.02	0.044							N
VI Montefí	Roman	-0.04	0.10	47	0.02	0.03							

Results of Mann-Whitney U-test: N, not significant; \* significant at the 95% confidence interval; \*\* significant at the 99% confidence interval; \*\*\* significant at the 99.9% confidence interval

TABLE 3  
*Capra hircus*: summary table for log ratios measurements.

Biniparratx Petit, where a goat of similar dimensions to the Early Iron Age assemblage of Montefí was found. In the Roman period, the goat maintains a size similar to that had in the Late Iron Age.

The log ratio histograms of cattle show the occurrence of a clear increase in size over time (Figure 5). In Mallorca, a tipping-point is identified at the 2<sup>nd</sup> century BC in the sample from Son Espases. The

measurements are significantly different between this site and the Early Iron Age samples (Table 4). Nonetheless, the Late Iron Age sample from S'Illot does not differ from the Son Espases sample, although an increase in size is perceived when comparing it with the *Pollentia* assemblages. In Menorca, cattle follow a similar trend. The increase in size is confirmed from the Late Iron Age to the

Roman periods. The Cercle de Cartailhac is the exception to this progressive change, as it contains striking large cattle.

Finally, the biometry of pig bones shows an increase in size over the two Roman periods (Figure 6). In Mallorca, the size trend shown by pigs parallels that of cattle. At the Early and Late Iron Ages there are no significant changes in size (Table 5). At

Site	Period	Summary					Statistical difference between sites (p)					
		Min.	Max.	n	Mean	SD	I	II	III	IV	V	VI
I S'Illot	Early Iron Age	-0.12	0.03	41	-0.06	0.035		N	N	***	***	***
II Son Fornés	Early Iron Age	-0.17	-0.02	18	-0.06	0.038			N	*	***	***
III S'Illot	Late Iron Age	-0.09	0.04	33	-0.05	0.023				N	***	***
IV Son Espases	2nd c. BC	-0.04	0.12	1830	-0.04	0.036					***	***
V Pollentia	1st c. BC- 1st c. AD	-0.08	0.15	50	-0.01	0.042						***
VI Pollentia	2nd - 3rd c. AD	-0.06	0.17	319	0.01	0.034						
		Min.	Max.	n	Mean	SD						
I Montefí	Early Iron Age	-0.13	0.00	13	-0.07	0.032		N	***	***	***	***
II Montefí	Late Iron Age	-0.13	0.04	18	-0.06	0.045			*	N	**	***
III Biniparratx	Late Iron Age	-0.15	0.01	71	-0.03	0.029				N	**	***
IV Talatí de Dalt	Late Iron Age	-0.10	0.06	23	-0.03	0.039					N	***
V Cercle de Cartailhac	Late Iron Age	-0.09	0.06	13	0.00	0.045						N
VI Montefí	Roman	-0.07	0.08	180	0.00	0.028						

Results of Mann-Whitney U-test: N, not significant; \* significant at the 95% confidence interval; \*\* significant at the 99% confidence interval; \*\*\* significant at the 99.9% confidence interval

TABLE 4  
*Bos taurus*: summary table for log ratios measurements.

Site	Period	Summary					Statistical difference between sites (p)						
		Min.	Max.	n	Mean	SD	I	II	III	IV	V	VI	VII
I Son Ferragut	Early Iron Age	-0.14	-0.03	5	-0.08	0.040		N	N	N	N	*	***
II S'Illot	Early Iron Age	-0.18	-0.03	33	-0.09	0.036			N	*	***	***	***
III Son Fornés	Early Iron Age	-0.17	0.00	47	-0.09	0.036				*	**	***	***
IV S'Illot	Late Iron Age	-0.18	0.03	25	-0.07	0.050					N	**	***
V Son Espases	2nd c. BC	-0.14	0.01	287	-0.08	0.001						***	***
VI Pollentia	1st c. BC- 1st c. AD	-0.09	0.03	101	-0.04	0.027						***	***
VII Pollentia	2nd - 3rd c. AD	-0.09	0.07	149	0.00	0.034							***
		Min.	Max.	n	Mean	SD							
I Montefí	Early Iron Age	-0.12	-0.05	4	-0.07	0.033							
II Montefí	Late Iron Age	-0.09	-0.03	14	-0.06	0.021			N	***	*	***	
III Biniparratx	Late Iron Age	-0.10	0.05	50	-0.04	0.031				***	N	*	
IV Talatí de Dalt	Late Iron Age	-0.05	0.04	13	0.00	0.027					***	**	
V Cercle de Cartailhac	Late Iron Age	-0.06	-0.01	14	-0.04	0.018						N	
VI Montefí	Roman	-0.10	0.08	62	-0.03	0.034							

Results of Mann-Whitney U-test: N, not significant; \* significant at the 95% confidence interval; \*\* significant at the 99% confidence interval; \*\*\* significant at the 99.9% confidence interval

TABLE 5  
*Sus domesticus*: summary table for log ratios measurements.

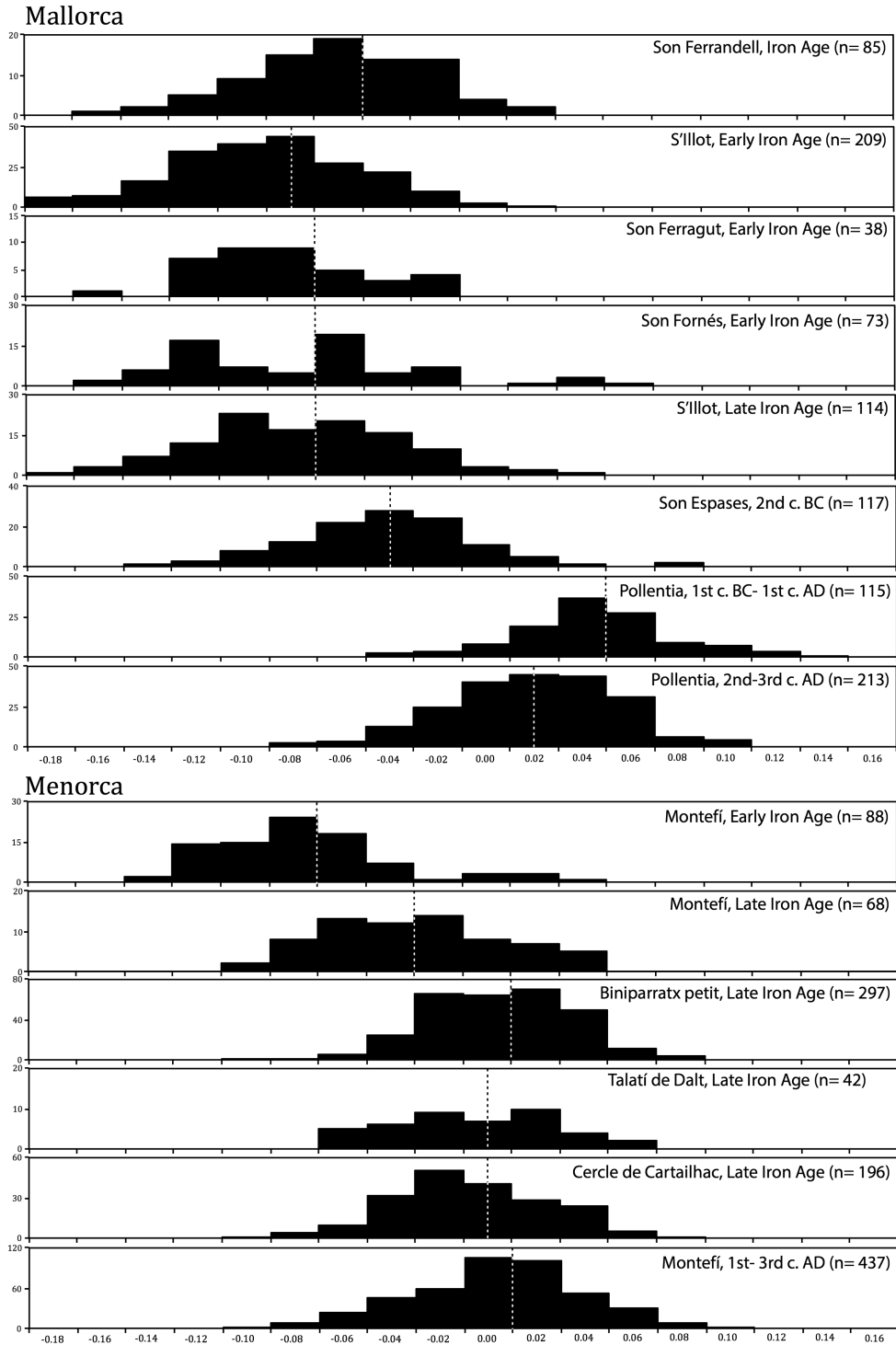
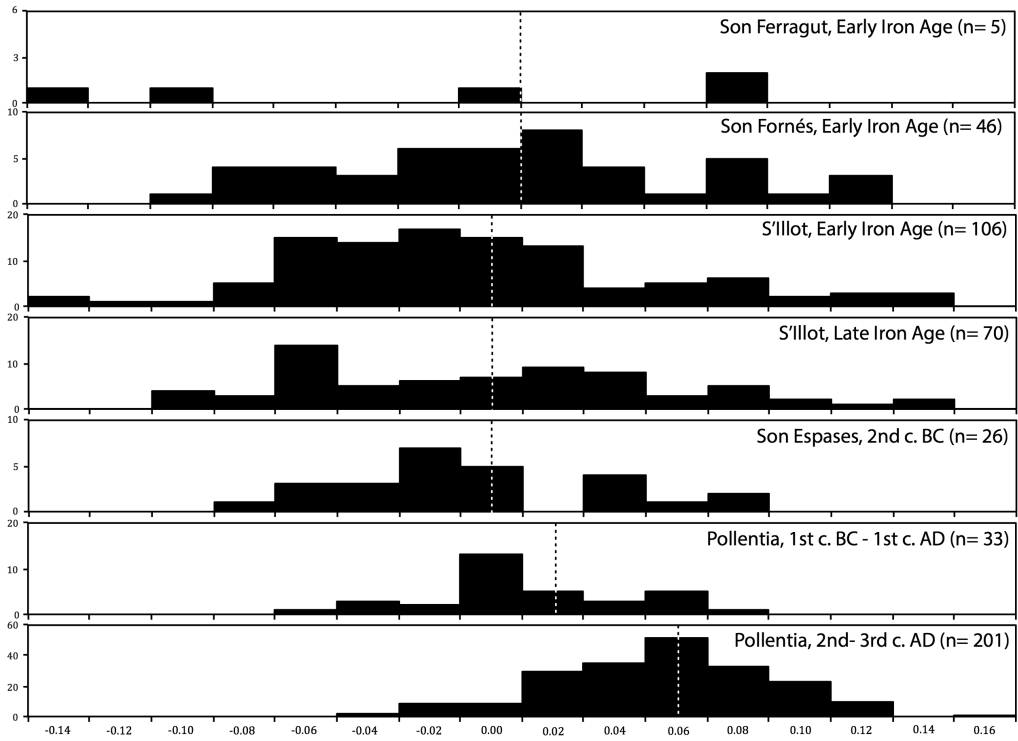


FIGURE 3

Log ratios of sheep post-cranial measurements from the different sites by period.



Mallorca



Menorca

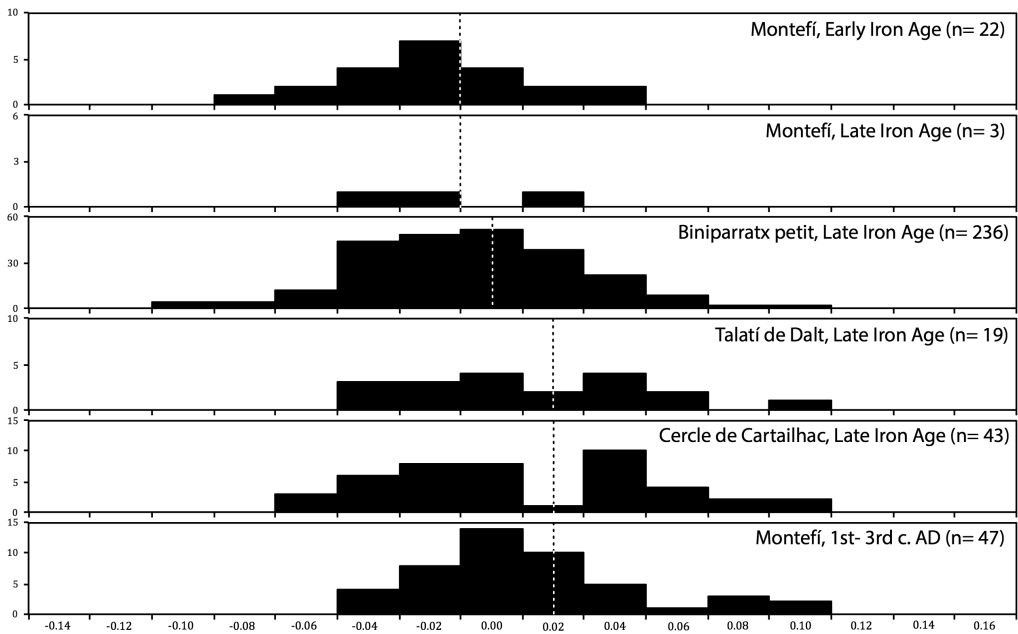
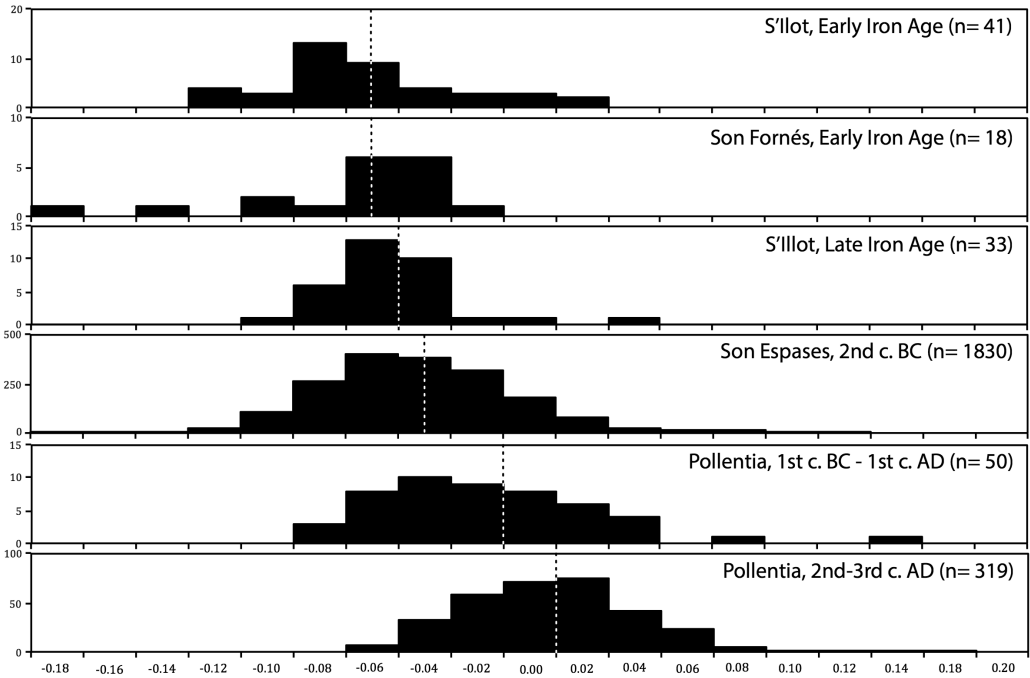


FIGURE 4

Log ratios of goat post-cranial measurements from the different sites by period.

Mallorca



Menorca

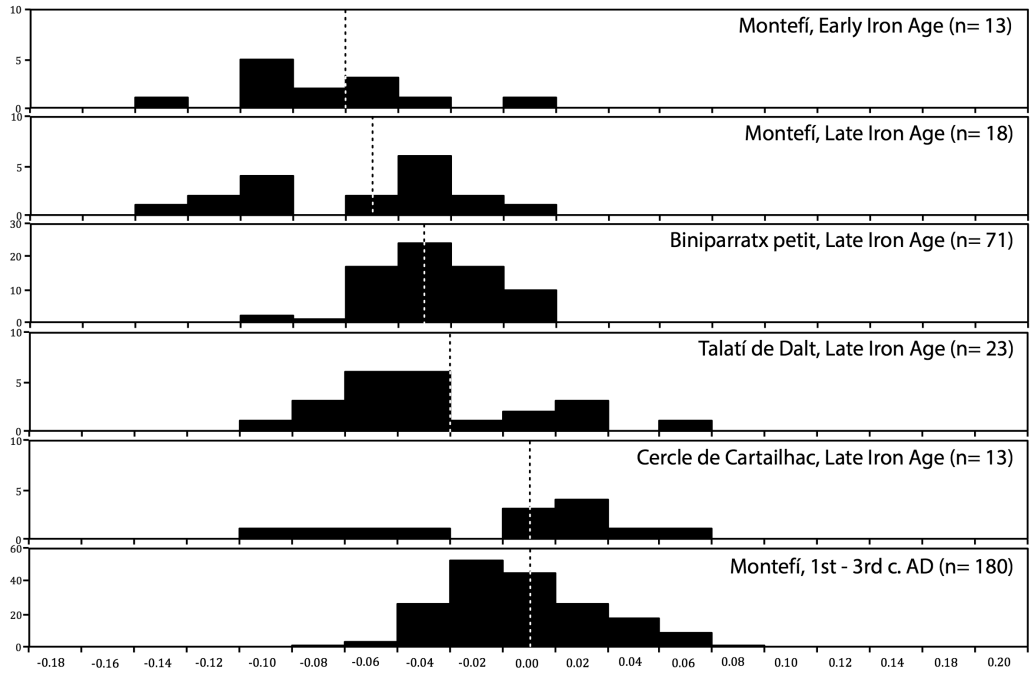


FIGURE 5

Log ratios of cattle post-cranial measurements from the different sites by period.

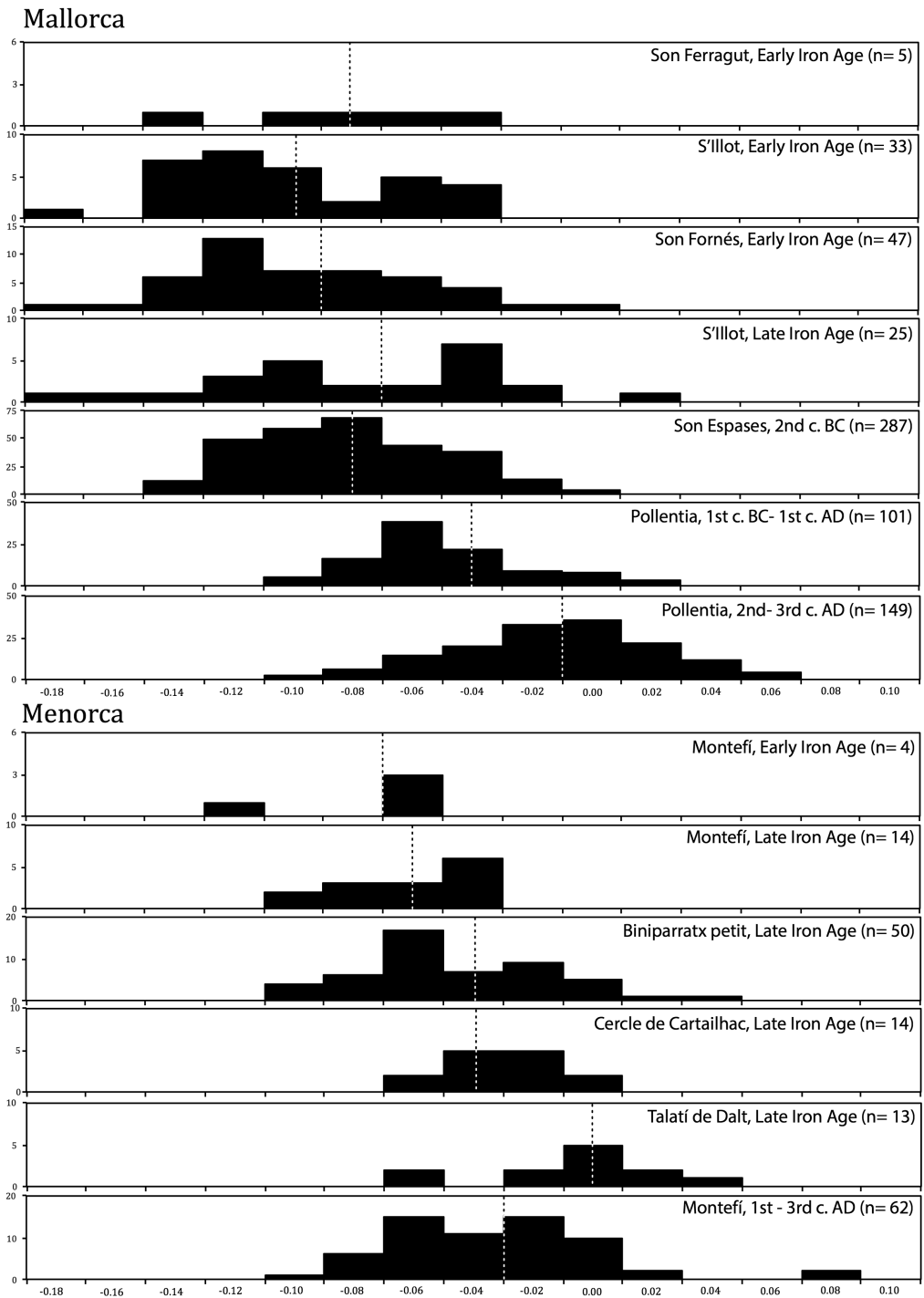


FIGURE 6

Log ratios of pig post-cranial measurements from the different sites by period.

the start of the Roman period, the animals are significantly larger than at prehistoric times. In Menorca, an increase in body size is attested to occur from the Late Iron Age. The Roman levels of Montefi show a larger pig than those of the last period of the Iron Age except for those from Cercle de Cartailhac.

## DISCUSSION

During the Iron Age, sheep and goat dominated the species pool over both islands. This dominance fits well with the extended view of a Balearic Iron Age economy based on a subsistence pastoralism based on sheep and goat. Some authors suggest an alternative mixed farming economy, especially at the Late Iron Age, and argue that the sheep/goat predominance could be more a reflection of environmental constraints than of a deliberate livestock management strategy (Hernández-Gasch *et al.*, 2002, 2011). The frequencies of sheep/goat appear to have remained unchanged throughout the Iron Age. There are just slightly fewer pigs and cattle at that last period. Nevertheless, there is a difference between the two islands. Throughout the Iron Age, the relative frequency of cattle is slightly higher in Menorca, increasing through time. This could be related to the better natural conditions offered by this island to raise large mammals (Casasnovas, 2005).

In the Roman period there is a change, evidenced by a trend towards higher cattle and pig average percentages. In urban contexts at that period, a substantial quantity of pig bones is recorded from the very start of the occupation. Although the amount of pig in *Sanisera* is significantly lower than in *Pollentia*, it constitutes a higher percentage than at the majority of settlements of the previous period. A pork-rich diet seems to be a regular dietary pattern in the Early Roman period, reflexing a 'Roman diet' influence (King, 1999, 2001), as it has been also attested in the Iberian Peninsula (Colominas, 2013). This animal, easily kept in towns, could reflect the increasing urbanization of the area.

The influence of the army is an important element in the discussion of the Roman impact on a new conquered territory. The consumption of meat by Roman soldiers has been much discussed (*e.g.*, Davies, 1971; Stallibrass & Thomas, 2008). In other areas, zooarchaeological research has provided di-

rect data from military contexts and show that the meat diet was largely based on beef (King, 1984, 1999, 2001). At the same time, the army needed the cattle as pack animals as well as to provide by-products such as leather for shoes or tents (Cavallo *et al.*, 2008). In Mallorca we have the key case of Son Espases, where there is a clear dominance of cattle. In Menorca, the case of *Sanisera* is less straightforward, but the representation of cattle (indicative of the consumption of beef) was also important.

Strikingly, in a sharp contrast to Mallorca, sheep and goats were still dominant in Menorca at the Roman period. We suggest here that this could be reflect of a lesser Roman influence on this island.

The size log ratios of the domestic mammals provide additional insights on the transition between the Iron Age and the Roman period on Mallorca and Menorca. In Mallorca there were no clear body size changes of domesticates throughout the Iron Age. It is worth mentioning that in a few cases some variation is noted, but the chrono-stratigraphical limitations of these samples impede the assessment of their real significance. In Menorca a more complex picture emerges. In general, the data show larger animals at the Late Iron Age. The problem of the Menorcan assemblages of Biniparratx Petit, Talati de Dalt and Cercle de Cartailhac is that they have been dated ambiguously between the 3<sup>d</sup> and 1<sup>st</sup> centuries BC. Thus, they indeed could be reflexing a post-Roman conquest situation.

However, the body size of these animals on the islands at prehistoric times is smaller compared to the recorded sizes of their mainland counterparts, as some authors have already pointed out (Uerpmann, 1971; Estévez, 1984b). These authors claim that their smaller body size should be the result of two converging factors, namely: little genetic exchange with other populations and ecological constrains on the island.

Otherwise, the results of the biometric analysis show the highly significant differences in body size since the Roman arrival compared to previous periods. In Mallorca, cattle, pig, and sheep/goat from the Early Roman period were clearly larger than the animals from the end of the Iron Age. This increase in size was sustained during the Mid-Late Roman period. The only difference in species percentages is that sheep showed a slight decrease in the Mid-Late Roman period. In Menorca, the data also points to an increase in body sizes of these animals, but in

a less clear grade. In any case, the mean body size of Roman domestic mammals exceeds the sizes recorded for the Late Iron Age sites.

The size of the post-cranial skeleton can be influenced by both genotypic and phenotypic factors (e.g., Albarella, 1997; Davis, 1997; Thomas, 2005). In the absence of more specific data (i.e., changes in teeth size), the increase in size of skeletal elements evidenced could be a consequence of selective breeding and/or of the introduction of a new stock. In either case, there is a clear trend to improve the livestock of the islands.

All these changes must be related not only to the exploitation of livestock and the products obtained from it, but also to the way it was managed to obtain a higher production. In this regard, the study of age-at-death profiles, based on teeth wear and epiphyseal fusion, is essential (Grant, 1982; Hambleton, 1999). Unfortunately, as we already pointed out elsewhere (Valenzuela *et al.*, 2013), the data required to elucidate these profiles are currently insufficient and impedes even the derivation of tentative conclusions.

## CONCLUSION

With the arrival of the Romans, major changes took place in the pattern of production and consumption of livestock in the Balearic Islands. The zooarchaeological record shows the occurrence of marked changes in the species representation and body size of the main consumed domestic mammals. Nonetheless, some differences can be traced between both islands. In Mallorca, the Roman influence seems to have been more pronounced and faster, while in Menorca some improvements could have been implemented initially but they did not go further.

This study not only reinforces the value of animal bones to illustrate all these differences, but also the limitations of the current data set. We hope that in the future new zooarchaeological studies will expand and improve these first results, and this important period of the Balearic Islands history consequently will be better understood.

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