ALEJANDRO G. SINER AND CESAR CARRERAS

METHODS OF PALAEODEMOGRAPHY: THE CASE OF THE IBERIAN *OPPIDA* AND ROMAN CITIES IN NORTH-EAST SPAIN

Summary. Ancient demography is a recurrent topic in archaeology, thanks to new methods and evidence from different surveys and excavations. However, different cultures or periods are studied on their own, without any comparison being made between them and of their population dynamics. The present paper seeks to advance the situation by defining methodologies to allow diachronic comparisons between two different periods and cultures. After setting out a methodological approach, the paper goes on to apply the same to a case study: namely the Roman conquest of north-east Spain, comparing the demography of the ancient Iberian communities (fourth-second centuries BCE) to the Roman colonization (first century BCE to first century CE). Roman urbanism is generally supposed to increase the population in a particular territory, but our present evidence refutes this point: a decrease in population is visible in urban or proto-urban sites from the Iberian to Roman periods, though there is an increase in the rural densities.

INTRODUCTION

Over two decades ago, one of us undertook an initial study on the demography of Roman *Hispania* (Carreras 1996), with the aim of calculating the approximate population of the Iberian peninsula. In addition, the research sought to elucidate urban and rural territorial patterns of distribution, based on cities' dimensions or field surveys. It coincided with a new interest in the subject of ancient demography after studies by Bagnall and Frier (1994) and Scheidel (1996) in Egypt, and by other scholars such as Millett (1990) in provinces like *Britannia*. This is not a new subject in our country, as it had been given a scientific footing by García Merino (1976) when she analysed the population of the *conventus Cluniensis* through its cemeteries and epigraphy. As happens in many Roman provinces, the two *Hispaniae* have not provided either censuses (Kron 2005; 2017) or ancient texts from which populations can be inferred (Hin 2013). Therefore, most of our source material was and is in the form of archaeological evidence.

Although scholars normally agree that the Roman conquest brought about an increase in urban population (Bowman and Wilson 2009), the present evidence from north-east Spain shows that in fact the 'concentrated' or 'urban' population did not grow between the late Iberian and the early Roman periods. The only possible rise in population seems to have involved the countryside (see below). Until the Second Punic War, north-east Spain fits well into a generic socio-political model

usually characterized as comprising archaic proto-states, where, at least from the fourth century BCE onwards, a consolidated and centralized power becomes concentrated upon a large *oppidum* (capital). These proto-states managed a rational and well-organized exploitation of the surrounding territory, including the establishment of its urbanism and settlement patterns. The natural evolution of these states was cut short in the late third-early second centuries BCE by the Roman conquest, after which these territories evolved in a quite different manner. The assertion that a natural growth in urban population occurred because of the benefits offered by the Roman conquest – through what is known as the process of Romanization – must certainly be questioned.

Nowadays, a multitude of methods exists that employ archaeological evidence to calculate the number of inhabitants of a particular site. The basic method identifies first the average size of a house in a particular community, and then infers an average family unit. In Roman times, this latter numbered between four and five members, the same average family size as that recorded in the first census in north-east Spain ('fogatges' – 1497 CE). The size of the average family, however, has decreased in modern times as registered in contemporary census data: 3.5 members are noted for rural towns in modern Egypt (1979) (Zorn 1994). Accepting this average figure of four to five members, the next point to be discussed is the space occupied by each family in the archaeological record.

Defining houses in pre-Roman and Roman settlements constitutes one of the main challenges that limit diachronic comparisons between periods; it remains a key issue for generating demographic values from archaeological data. Not all architectural structures in a settlement were houses, and a minimum living space per person must be assumed. The density generated from different sites and house-types may range from 150 to 1700 inhabitants per hectare (see Table 6).

A simpler calculation than that derived from establishing the relation between dwellings and families involves the total intramural extent of a settlement. In doing this, though, generally there is a level of assumption made – thus introducing a margin of error that must be borne in mind – that this figure is equivalent to all the space within the perimeter of the walls. Once calculated, the number is multiplied by the standard density of population per hectare. A more sophisticated calculation distinguishes between the dwelling space (approx. 60%) and public area (40%) within a settlement (Gracia *et al.* 1996, 182; Isoardi 2012). Of course, ancient sources and archaeological evidence record the existence of towns with *insulae* of more than one storey, such as Rome or Ostia, as well as cities that devoted a greater space to public buildings (i.e. streets, temples, *fora* and similar).

Though there are several methods of calculating ancient populations from archaeological data, none is particularly reliable since they suffer from a great unpredictability. For instance, calculations of the capacities of public buildings such as amphitheatres or theatres¹ suggest that many actually exceed the total population of the city they serve, because they offered entertainment to the citizens of nearby rural areas or even of the whole province. In north Italy, comparison between population size, according to intramural area, and the amphitheatre capacities makes all too clear the difficulties involved in using such entertainment buildings to estimate the number of urban residents (Table 1; De Ligt 2012).

Further, calculations of populations based on water supply are even more complicated, since most water available in ancient towns may have been used for requirements other than the household, such as bathing or industry (Vitruvius 8.6.1-2; Frontinus, *De Aquaed. Urb. Rom.* 1.23).

A clearer source may be found in cemeteries and epigraphy. In the latter case, scholars agree that the accessible data only reflects a part of the total population, depending on wealth,

1 Normally, calculations of building capacities take into account the minimum space between spectators (40–50 cm), numbers of rows, distance between rows, and the length of the curve of each row.

TABLE 1

Comparison between populations calculated from areas or public buildings in cities of north Italy (De Light 2012)

City	Population area x density per ha	Amphitheatre capacity
Mediolanum	12,000	31,634
Verona	7500	30,451
Aquileia	10,500	26,384
Parma	4500	16,152
Ariminum	6150	13,918
Forum Livii	4500	13,848
Forum Iulii	1875	13,848
Forum Cornelii	4800	11,970
Aosta	6255	9765
Eporedia	4500	8042
Patavonium	19,500	7220
Libarna	3450	5397
Segusium	2250	3014

gender, age, etc. In addition, epigraphic monuments were basically fashionable only during the Principate. Regarding cemeteries, one understands readily that they only provide a partial level of information because they have not been totally excavated; the cremation ritual also generates problems. Further there is far less evidence concerning life expectancy or death rates for the populations of pre-Roman north-east Spain. A few formulae attempt to calculate populations by combining information from cemeteries, houses in the settlement, and death rates and evidence for age at death, such as those presented by Neustupny (1983) and Wells (1984):

Formula 1: $D+ = R \times Pr \times d \times Px$.

Where: **D+** (number of tombs) = (**R**) (number of houses in the settlement) **x** **Pr** (average size of a family) **x** **d** (death rate) **x** **Px** (proportion of individuals over a referenced age) (Neustupny 1983, 7–34).

Formula 2: $D \times e/t$

Where: **P** (number of population) = **D** (number of tombs) **x** **e** (life expectancy) / **t** (time) (Wells 1984)

McIntyre (2015) calculates the population of Roman York (*Eboracum*) by using both settlement size and burial data. The second method requires knowing the number of burials (in relation to the potential burial ground), site occupation length, and estimation of life expectancy (32.36 years).

POPULATION IN THE IBERIAN PENINSULA

In a previous paper, an attempt was made to establish a possible population figure for the Roman provinces in the Iberian peninsula through employing all the available palaeodemographic methods using archaeological evidence (Carreras 1996). Only a few ancient writers refer to the

Figure 1

Map showing the 209 urban sites with intramural sizes (Carreras 2014). [Colour figure can be viewed at wileyonlinelibrary.com]

population of Hispania. During the second century CE, Appian (*Iber.* I.4) mentions that ‘many people of many different names inhabit it’. Previously, Pomponius Mela (II.86) in the first half of the first century CE had said that ‘Hispania was abundant in men’. In Late Antiquity, Isidore of Seville (Isidorus, *Hist. Goth. De laude Spaniae*: 168–169) states that ‘its territories are rich in children’.

However, our best source of information is Pliny the Elder (*NH* III.3.7–17; IV.4.18–30; IV.35.113–118), who in the mid-first century CE cites 399 urban entities (*civitates* and *populi*). The aim was to calculate the intramural size of those 399 urban entities, and thereby the whole urban population. The intramural areas of only 107 Roman towns were recorded at that time (Carreras 1996), but these figures, updated in 2014 (Carreras 2014), reached a total of 209 urban centres (Fig. 1). Depending on the density of inhabitants per hectare defined for the urban sites, the total urban population would be as shown in Table 2.

As regards the rural population, Pliny the Elder (*NH* III.3.28) refers to the number of free inhabitants in the three north-west *conventus* (*Asturum*: 240,000; *Lucensis*: 166,000 and *Bracarenis*: 285,000²). If the urban population of each of those *conventus* is subtracted, the remaining rural population totals are 201,395 in the *conventus Asturum*, 141,690 in the *conventus*

2 Simili modo Bracarum XXIII civitates CCLXXXV capitum, ex quibus praeter ipsos Bracaros Bibali, Coelerni, Callaeci, Equaesii, Limici, Querquerni citra fastidium nominentur.

TABLE 2
Urban population in the Iberian peninsula

1,250,213	1,165,198	1,000,170
250 p/ha	233 p/ha	200 p/ha

Lucensis, and 244,922 in the *conventus Bracarenensis*. Since the approximate geographical extent of those *conventus* is known, densities of population per km² can be estimated (*Asturum*: 5.1; *Lucensis*: 6.3; *Bracarenensis*: 12.2; Carreras 1996, 102–108). The average density is thus 7.87 inhabitants per km², which could be applied to the whole Iberian peninsula, reaching a total rural population of 3,132,864. Therefore, the total population for the Iberian peninsula would be between 4 and 4.3 million inhabitants, of whom 25% were urban and 75% rural dwellers. Though the densities applied to urban areas may be debatable, calculations carried out by authors such as Gozalbes (2007) accept a similar value of around 4–4.5 million with a density for urban centres around 225–250 inhabitants per hectare.

Figure 2

Map of north-east Tarraconensis with the main Iberian *oppida* and Roman towns. [Colour figure can be viewed at wileyonlinelibrary.com]

However, one of the most interesting conclusions drawn from that exercise was the population's distribution pattern, which contradicts previous conceptions. Most large and medium-sized cities were concentrated inland, along the Ebro, Duero and Guadalquivir valleys rather than in the coastal regions (see Fig. 2) (Carreras 2014, 57, fig. 3).

This pattern means that the Roman distribution of population probably repeats an underlying indigenous substrate, rather than reflecting Italo-Roman urban foundations and new infrastructures. To appreciate this will require a diachronic analysis from pre-Roman Iron Age populations to Roman times, taking into account the urban and rural patterns. Here lies the main problem in our palaeodemography, namely that Iron Age and Roman scholars employ different methods and values, so any such diachronic comparison becomes complicated.

HOW TO CALCULATE LIVING SPACE

Previous studies considering the palaeodemography of the *oppida* of Iron Age Spain developed certain fundamental premises and analytical methodologies. The estimates (Gracia *et al.* 1996, 82–4) were based on the following formula: household surface (henceforth HS) = total surface of the settlement (henceforth TS) – community surface (henceforth CS). In those cases where CS could not be calculated because the archaeological remains were not sufficiently preserved or studied, a proportion of 60% to 40% was established: the former number (60%) being the HS and the latter (40%) the CS (Gracia *et al.* 1996, 182). These percentages were obtained from the layout of several *oppida* around the mouth of the river Ebro and dated between the seventh and second centuries BCE.

The next step, establishing average household size (henceforth HA), starts from the premise that structural types were similar in *oppida* located in adjoining territories and sharing a similar chronology of occupation (early Iberian and classical Iberian periods). The authors estimate the HA to have been 24.4 m². Therefore, the number of households (henceforth NH) in any *oppida* belonging to the area and chronological period studied may be arrived at by the following calculation: $NH = 60\% \text{ of } TS/HA \text{ (24.4 m}^2\text{)}$.

Finally, once the NH inside the *oppida* studied has been obtained, it needs to be multiplied by the average number of inhabitants per household (henceforth IH), which the authors estimate to have been four or five. However, we should note that this value is not universally accepted.

The aforementioned methodology, although laying excellent foundations, has one considerable drawback: it is too generic. It assumes that all the *oppida* from the same area and period will have similar sized households, which is not true (Belarte 2010); the ratio of 60% (HS) vs 40% (CS) also needs to be proved in other areas and communities. In addition, this methodology does not work for those *oppida* with very unequal household sizes, for instance examples of both 200 m² and 50 m² are known.

THE INHABITANTS/HOUSEHOLD RATIO

For pre-Roman Gaul, Py (1996, 251), in a substantial synthesis studying the houses of the *oppidum* of Lattara (Lattes, Hérault), asserts that 93% of the structures cover less than 66 m² each and that it is difficult to imagine anything other than a nuclear family of four to six individuals (including children) occupying each household. Isoardi (2009, 71–2), although reluctant to estimate the number of inhabitants for the *oppida* of pre-Roman southern Gaul and basing her numbers on

the previous studies of Dedet (1987, 172, 205–6; 1999, 313–14) and Py (1996, 251), estimates the most plausible number of inhabitants per household to have been five (Belarte 2010).

Turning to the figures suggested for Roman times, nothing seems to have changed much. One of the best supported estimates is that carried out by Kennedy (2006) using the 167 family census from Egypt (4.3 inhabitants per household). For the city of *Hermopolis*, Bagnall and Frier (1994, 55) suggest 5.3 inhabitants per household, justifying this number on the preserved census declarations. Based on this study, though, Carreras (1996) established an average of four people per household or family, instead of the 5.3 proposed by the original authors. This estimate was in accordance with the 136 complete censuses recovered so far. However, if the 41 partial censuses also known were included, the mean would indeed increase to 5.3 members per household, as Bagnall and Frier (1994, 67) pointed out in their book.

If we now consider the medieval and modern censuses preserved for the area under study, several figures can also be obtained. In 920 CE, in the village of Baen (Catalonia, Spain), 80 inhabitants belonging to 18 families can be counted, giving us a number of 4.4 persons per family (Salrach 1982, 209–10). In 1378, the population of the city of Barcelona (Catalonia, Spain) was 34,447 individuals belonging to 7655 households. This makes the number of inhabitants per household in Barcelona during the 14th century 4.49 (Iglesias 1962; 1981; 1991). In the 1631 census of the city of Girona (Catalonia, Spain), 4900 persons were counted in a total of 1292 households, giving us a total of 3.79 inhabitants per household (Alberch and Castell 1985).

A long list of estimates could be cited here. The size of the family has been and still is a fundamental topic in any demographic study, whatever the region or period under study. However, for the purpose of this article – as set out in Table 3, we have a sample large and uniform enough to state with confidence that, when dealing with pre-industrial societies, the most acceptable inhabitants/household ratio seems to be somewhere between four and six individuals per household (Hanson and Ortman 2017, 305). In order to avoid a constant repetition of mathematical operations (calculations using four, then five and then six individuals), the figure of four inhabitants per household will be used for two practical reasons: first, it is the same number that Carreras (1996) used in his calculations for Roman Spain and therefore will facilitate comparison between the two studies (see below). Second, using the lowest estimate seems the best way to proceed since in many cases we are dealing with houses that are small and barely manage to provide the minimum living space of 10–12 m² (see Table 4).

TABLE 3
Summary of different estimates put forward to determine the number of inhabitants per household

<i>Oppidum</i> /City/Territory	Household members	Reference
Pre-Roman Gaul (Languedoc)	5	Isoardi 2009, 71-2
Lattara (Lattes, France)	4-6	Py 1996, 251
Pre-Roman NE Spain (Iberian <i>oppida</i>)	6-7	Gracia <i>et al.</i> 1996, 181
Pre-Roman NE Spain (Iberian <i>oppida</i>)	4-5	Gracia <i>et al.</i> 1996, 183
<i>Hermopolis</i> (Roman Egypt)	5.3	Bagnall and Frier 1994, 55
Roman Spain in the Early Empire	4	Carreras 1995-1996
Barcelona in the fourteenth century	4.5	Iglesias 1962
Early Modern Spain (1755)	4-5	Iglesias 1979
Native American Communities	4-5	Hassan 1981, 73
Broken K Pueblo	6.1	Hill 1970
Western Pueblo Indians	5.5	Turner and Lofgren 1966, 117-32
Pueblo Indians	5.03	Steward 1937, 87-104

TABLE 4
Estimate of minimum living space per person in Roman cities

City	Area	Minimum living space per person	Reference
Pompeii	64-67 ha	35 m ²	Wallace-Hadrill (1994, 91-117)
Sabratha	31 ha	10-20 m ²	Storey (1997, 969-73)
Timgad	9.96 ha	20-25 m ²	Storey (1997, 969-73)
Hermopolis	120 ha	19 m ²	Bagnall and Frier (1994, 55)
Lattes	3.5 ha	10-12 m ²	Py (1996, 251)

MINIMUM LIVING SPACE (LS)

If an average size of 4–5 individuals for each household can be agreed upon, how can this household be recognized in the archaeological structures? Different sizes for households are known from excavation, which are understood to have been inhabited by different family sizes. Calculations for Pompeii (large families with 7–10 members or nuclear families having 4–5 members: Wallace-Hadrill 1994, 91–117) when combined with those by Storey (1997, 973–4) for the city of Rome have led to the conclusion that every person occupied an average space of 35 m². Of course, whether a family occupied a larger or smaller surface area would have depended on its status, but at least 35 m² provides some measure of living space (LS) to work with. Given that Pompeii covered an area of about 64–67 ha, it can be calculated from the number of households that the density stood at 166–175 inhabitants per ha. See Table 5 below.

Storey (1997, 969–73) also calculated the population of the North African city of Sabratha, covering 31 ha, of which only 25.4 ha were dwellings (81% of surface area). The average household occupied 100 m², so the personal living space could have ranged from 20 m² (nuclear family of five members) to 10 m² for an extended family (10 members). Likewise, Py (1996) says that 93% of households in the Iberian *oppidum* of *Lattara* (south Gaul) had less than 50–66 m², representing a living space (LS) of around 10–12 m² for a family of four to five members. Similar numbers (10 m²) were suggested by Naroll (1962, 588) when estimating the population of 18 different prehistoric societies.

Another case study provided by Storey (1997, 969–73) refers to the city of Timgad, which covers an area of 9.96 ha, with 109 identified households. The average size is thus 100 m², so each member of a nuclear family would have enjoyed at least 20–25 m². The last example is *Hermopolis*, an Egyptian city of 120 ha studied by Bagnall and Frier (1994, 55). Two of the four quarters here had 4,200 households (*oikia*) according to papyrus SPP V.101. The authors calculated that the four quarters of the city might have contained a minimum of 7,000 houses. Considering that only 60% of the city was occupied by households (72 ha), the average household size was 102 m². Bagnall and Frier (1994, 55) also referred to the census of the city: if the average family had 5.3 members, the living space of each inhabitant was 19 m².

TABLE 5
Estimated density per ha in Roman cities

City	Total population	Density per ha	Reference
Pompeii	11,000-11,500	166-175	Wallace-Hadrill (1994, 91-117)
Sabratha	5148-19,989	166-414	Storey (1997, 969-73)
Timgad	2844-3555	286-357	Storey (1997, 969-73)
Hermopolis	37,100	309	Bagnall and Frier (1994, 55)

If these household population densities are applied to the whole inhabited area within cities (approximately 60%), the absolute population as well as the average density can be obtained. For instance, the total population of *Pompeii* according to Wallace-Hadrill (1994, 91–117) and Storey (1997, 973–4) reached 11,000–11,500 inhabitants, with a density of 166–175 citizens per ha; whereas Flohr (2017) estimates a minimum of 7250 and a maximum of 11,750 inhabitants. Other calculations appear in the following Table 5.

These urban population densities for Roman cities obtained from archaeological and census data differ only little from the values used by different scholars for urban populations in general, with perhaps the exception of the highest possible estimate for Sabratha. Similar densities are recorded by Hassan (1981, 85) with densities between 150 and 250 inhabitants per ha. Hanson and Ortman (2017) have defined a series of urban densities on the basis of archaeological residence areas, which reach similar densities per ha of 100–500 inhabitants from a sample of 885 Roman cities, although some densities below 100 are questionable (Hanson, 2016).

In short, while there is considerable variety of population density, the estimates put forward for Roman cities seem to range quite uniformly between 150 and 350 inhabitants per hectare. In addition to those evaluations based only on archaeological data, we also have the information offered by the ancient sources (Table 6) when discussing Roman colonial foundations in northern Italy in the years of their construction. In these cases, the literary evidence for colonist numbers can be matched against the archaeological evidence for the original city wall circuit.

Unfortunately, the uniformity in the estimates of inhabitants per hectare proposed in the time span above is not matched by the far more heterogeneous results in the period preceding the Roman conquest. Hansen (2006) did indeed establish an average density between 150–300 inhabitants per hectare for 200 Greek poleis in the fourth century BCE, but numbers ranging from 200–250 inhabitants to above 1750 have been suggested for the Iron Age in Spain (Gracia *et al.* 1996).

The problem lies in how to calculate populations of Iberian *oppida* according to their archaeological features: CS (or 40% intramural size), HS and IH. A suitable methodology that has been applied to a series of Iberian *oppida* offers some initial insight and general patterns.

DEMOGRAPHIC POPULATIONS IN PENINSULAR OPPIDA

Castellet de Bernabé (1000 m²) is the perfect example to work with, not only because all its structural remains are preserved in excellent condition (Fig. 3), but also because it has been excavated using modern stratigraphic methods, and the results of these excavations were published in a detailed monograph (Guerin 2003). We already know the value of NH; so it only necessary to multiply that number by the IH assigned to obtain an estimate of the total number of inhabitants: $18 \times 4 = 72$. Once we have the estimate of inhabitants, that number just needs to be divided by the TS in hectares – and the density of inhabitants per hectare will be obtained: $72/0.1 = 720$. In order to obtain

TABLE 6
Population densities of newly founded Roman coloniae. (Kron 2017, 76, fig. 6, see also Conventi 2004)

Colonia	Area (ha)	Population	Density per ha	Date
Augusta Praetoria	42	12,000	288	25 BCE
Bononia	50	12,000	240	189 BCE
Comum	25	12,000	482	89 BCE
Aquileia	41	13,440	328	181 BCE
Concordia	40	12,000	300	42 BCE

Figure 3

a) Plan of Castellat de Bernabé (Guerin 2003, 160, fig. 244); b) Plan of Castellat de Bernabé showing the rooms that cannot be counted as households (Guerin 2003, 160, fig. 244, modified by the authors). [Colour figure can be viewed at wileyonlinelibrary.com]

the CS value, we need to measure the surface of the central street, including the space occupied by the cistern (240 m²), and the surface of those rooms not considered to belong to households (200 m²) and add the figures (240 m² + 200 m² = 440 m²).

The Iberian *oppidum* known as Els Estincells (Verdú, Spain) is another example of a fortified Iberian settlement. Inside the defensive wall, an oval area of around 2000 m² is delimited (Asensio *et al.* 2009, 125). The excellent preservation of the western half of the *oppidum* has enabled several households – up to 15 – to be measured and compared (Table 8), providing a clear picture of the uniformity and parity of all the constructions in the settlement. This regularity argues strongly for a comparable symmetry for the missing buildings. There are three different kinds of households inside Els Estincells (Fig. 4). The simplest – and the smallest – rooms (20, 21, 22, 23 and 24) consist of only one space, with regular surfaces between six and 13 m².

The small dimensions of the type 1 structures make them unlikely to have had a residential use, as indeed the archaeological team of Els Estincells have suggested (Asensio *et al.* 2009, 138). An alternative identification would see them as areas mainly specializing in community activities, such as craftsmanship and/or other economic activities that are often present at Castellat de Bernabé. Their physical segregation from the main range of houses (types 2 and 3) also points in this direction.

As stated above, a living space per person between 10 and 12 m² (Naroll 1962; LeBlanc 1971) is taken here as realistic. Therefore, those units with a surface area under such measurements will not be taken into account, unless there is very clear evidence of their function as households. If that is the case, it will be necessary to re-evaluate the number of inhabitants assigned to such units since they clearly cannot have housed 4–5 persons on a regular basis.

Figure 4

Different types of houses recorded at Els Estincells (Asensio *et al.* 2009, 130, fig. 4).

Another important feature of the settlement that should be counted as CS is the existence of a large open central area of around 500 m². This area is delimited by the only street present in the settlement and the cistern (Fig. 5) (Asensio *et al.* 2009, 128). If we calculate the likely surface of these three elements – open central area, cistern and the street, one arrives at a total surface of approximately 700 m² of CS. Finally, if we add to these figures the surfaces of structures 20–24, a minimum of 750 m² of community spaces can be certified. These numbers are very useful to test the effectiveness of using a ratio of 60% HS vs 40% CS when accurate measurements cannot be taken elsewhere due to the poor preservation of remains. 40% of 0.2 ha. is 800 m², a figure very close to the 750 m² estimated for Els Estincells.

It is quite clear that the HA values estimated by Gracia *et al.* in 1996 (24.4 m²) do not match the reality of the houses that have been preserved at Els Estincells (average of 42.4 m²). However, we do have examples at the site of fully or partially preserved houses large enough to conjecture that the missing houses might be similar in size either to those of type 2³ or type 3 (Fig. 5).

Belarte (2010, 114) also refers to this wide range of household sizes in the classical and late Iberian periods at sites such as Ullastret, with houses from 20 m² to 40–50 m² and even 100 m². Likewise, Castellet de Banyoles (Tivissa) presents buildings of 70–75 m² to 250–360 m². Belarte underlined the fact that the larger households usually appear in the most complex (and larger) *oppida*, which is a point that has also been tested in our different case studies (see Table 9). By the formula quoted above (that HS = TS – CS) and since it is already known that here TS = 2000 m² and of that area a minimum of 750 m² was for CS, we are left with a very straightforward calculation: HS = 2000–750. Therefore, HS = 1250 m².

The next step follows on readily: if we have a HS of 1250 m² and the average size of the plot used to construct these houses is around 42.4 m², then the total number of houses at Els Estincells will be the result of 1250 divided by 42.4, that is to say 29 houses (Standard Error – SE – 1.98).⁴ Once again, to move from houses to inhabitants is simple: NH is multiplied by IH (29 x 4 = 116) (SE 7.92). To obtain the density of inhabitants per hectare the estimated number of inhabitants must be divided by the number of hectares that the site occupies: 116/0.2 = 580 (SE 39.6).

3 Considering that all houses of type 3 are concentrated on the west side of the *oppida* and close to the cistern, it would seem very feasible that the missing houses on the east side of the *oppida* are more similar to those of type 2.

4 In order to make the accuracy of our estimates (see Table 7) accessible to the reader, we have applied a standard error (SE) to each of our calculations (NH, IH and density per ha.). The standard error is a measurement of the statistical accuracy of an estimate, equal to the standard deviation of the theoretical distribution of a large population of such estimates (Devore 2012).

Figure 5

Plan of Els Estincells (Plan courtesy of Els Estincells archaeological team, modified by the authors).

Due to the partial preservation of the archaeological remains, this methodological procedure will always carry a certain margin of error. The larger the uncertainty as to the size of a site (unexcavated or missing) and the larger the difference between the areas of the known houses will increase the greater are the chances of inaccuracy.

When each *oppidum* being here considered has been processed, following the same methodological approach, it becomes obvious that, while the densities of these settlements are higher in general than those estimated for the Roman period (400–800), the variability between sites is not as diverse as believed in the past (see Table 7). The only clear outlier is Puig Castellar with an average house size of 21.5 m², and therefore less than 5.37 m² of LS for each inhabitant. If we accept that the minimum LS should be at least c. 10 m² and we apply those numbers to Puig Castellar, the following results are obtained: HS = 0.35 – 40% (CS) giving us a final HS of 2100 m². Dividing this number by the average house size (21.5 m²) yields the conclusion that the settlement had 97 houses. If we assign two inhabitants per house instead of four following the criteria explained above, we obtain a total population of 194 persons.

Finally, we can obtain a density of 554 inhabitants/ha, by dividing 194 persons by 0.35 (TS). Similar corrections could well be applied to the cases of Moleta del Remei and Castellvell, for which, based on their average household surface size, an estimate of an average of three persons per household might seem more suitable than four. It is important to highlight that, when we take into account the variable of minimum LS, the lowest estimates calculated in Table 7 seem more realistic than the highest. Therefore, it seems more appropriate to apply estimated densities between 425 and 650 inhabitants/ha, when the archaeological data is extremely poor and the populations can only be calculated by dividing the total surface of the settlement by a specific density obtained from other case studies.

TABLE 7
Estimated density calculated using our methodological approach of several oppida in pre-Roman Spain

Iberian <i>oppida</i>	Average house	Size in ha	Density per ha
Puig Castellar (Sta.Coloma)	21.5 m ²	0.35 ha	1108 (SE 87.19)
Els Estincells	42.4 m ²	0.2 ha	580 (SE 39.6)
Bolvir	50.3 m ²	0.6 ha	426 (SE 78.33)
Moleta del Remei	30.7 m ²	0.5 ha	784 (SE 46.32)
Molí d'Espigol	40 m ²	0.8 ha	775 (SE 150)
Font de la Canya	38.4 m ²	0.07 ha	629 (SE 60.9)
Castellvell (Solsona)	31.4 m ²	0.49 ha	759 (SE 138)
Sant Julià de Ramis	40.9 m ²	0.7 ha	582 (SE 75.77)

RURAL DEMOGRAPHIC METHODOLOGIES

With regard to estimates of rural populations, the census quoted by Pliny the Elder (*NH* III.3.28) for the three *conventus* of north-west Tarraconensis produce a range of densities for inhabitants per km² (*Asturum*: 5.1; *Lucensis*: 6.3; *Bracarensis*: 12.2). The average of these three values would be a density of 7.87 inhabitants per km², which may have been an appropriate value for the whole Iberian peninsula. Likewise, Hin (2013, 303–5) records similar differences in rural densities in regions of Roman Italy, which she believes were due to variations in the living conditions and the resources of each territory.

Most studies that provide estimates of six million inhabitants for the Iberian peninsula, such as Corvisier and Suder (2000), were based on rural densities of 10.1 inhabitants/km² (Aüsbuttel 1998), with no special argument to justify this figure. However, other similar provinces have been assigned lower densities *Gallia* (7.7 inhabitants/km²), *Greece* (7.5 inhabitants/km²) or *Africa* (7.5 inhabitants/km²), closer to the average estimate obtained from Pliny's figures.

The first recorded census in the north-east Spain (1497) recorded an average density of population of 12 inhabitants per km² (Iglesias 1979), of whom a quarter were urban inhabitants. Therefore, the average rural density was around 9–10 inhabitants per km², in other words two 'hearths' ('fogatges' in Catalonia – each of four or five family members). This figure is not far from the 7.87 inhabitants per km² obtained in Roman times. Fig. 6 illustrates an interpolation of the densities by county from the 1515 census, which reveals a population distribution that may compare well with that of other earlier agrarian societies, such as those of the Roman or Iberian periods. Of course, the pattern of distribution will differ due to the existence of territories where were sited the main cities such as Barcelona, Girona, Tarragona, Vic, Lleida and so on. Their presence results in higher rural densities nearby, with lower densities appearing in mountainous and inland areas.

Apart from ancient texts and comparisons with other historical periods, rural populations can only be inferred from archaeological survey data. Since the mid-1990s, demographic studies in Roman Italy (Laurano 2011; Hin 2013, 298–341) have taken archaeological survey data into account, though the methods of their interpretation remain open to contention. Calculations of rural populations based on archaeological surveys depend on:

- a Site size: this normally refers to the material-scatter extent, which may be affected by many post-depositional processes. Modern methods employing GPS exist to define concentrations in material scatters (see Grau 2014)

Figure 6

Distribution of rural population in north-east Spain, according to the 1515 CE census. [Colour figure can be viewed at wileyonlinelibrary.com]

- b Recovery rates: this refers to the total number of sites identified in the survey in relation to the ones that existed in the past. A rate of 50% is normally assumed (Hin 2013, 312)
- c Number of inhabitants per unit: this refers to the different categories of sites, depending on their physical extent, and the particular number of dwellers associated with the same

If a 50% recovery rate is accepted, the key issue is to evaluate the patter of material scatters that identify particular types of rural sites. Some surveyors have defined rural site categories without

reducing the ‘halo’ effects produced by post-depositional processes. For instance, Fentress (2009) uses data from her Djerba survey and also the one in Etruria (Perkins 1999) to establish the following categories according to scatter dimensions:

- Large *vicus* – 80 people (800 m²) – 10 m² per person
- Large villa – 50 people (500 m²) – 10 m² per person
- Small *vicus* – 40 people (400 m²) – 10 m² per person
- Small villa – 30 people (300 m²) – 10 m² per person
- Large farm – 10 people (100 m²) – 10 m² per person
- Small farm – 5 people (60 m²) – 12 m² per person

In appraising these values, it seems somewhat strange that the human LS on rural sites should be taken as identical to the minimum defined for urban sites (see Table 4, 10–12 m²), given that rural sites include production areas such as warehouses, workshops, stables or presses.

Some field survey experiences in the Alcoi valley (Alacant, Spain) (Grau 2014) illustrate how difficult it can be to relate material scatters to archaeological settlements. One of the surveys, at El Carrascalet, covered an area of 18.5 ha, which was field-surveyed by transects to record material concentrations. The highest density of pottery was concentrated in a space of 1.1 ha, which was later surveyed by geophysics (resistivity), registering some minor anomalies. These areas were excavated, but no signs of structures were revealed, despite the presence of ancient materials. Another survey at Torre Redona revealed three pottery concentrations for different chronological periods (Iberian and Roman). The Roman concentration covered an extent of almost 0.5 ha, which was surveyed by geophysics (resistivity), with anomalies only being traced in one area of 900 m². Later archaeological exploration yielded two buildings, one covering around 200 m², which was probably the dwelling, and the other of 100 m², with a possible agricultural function. Therefore, only a small area of scatter may identify the LS of a group of people.⁵

The values defined above are the ones employed by Witcher (2005) in his study of Rome’s suburbs (up to 50 km around the city) and are based on different surface surveys. From the 323 km² surveyed, he identified an average of one villa and two farms per km², so providing a total number of 18,100 theoretical settlements (with a 1:2 ratio between *villae* and farms) in the 50 km-zone around the city of Rome (Morley 1996). Multiplying those theoretical settlements by their potential dwellers, he concluded that the hinterland of Rome supported a density of 60 inhabitants/km².⁶ With similar site categories and inhabitant numbers for each category, Fentress (2009) established an average density of 30 inhabitants per km² for her survey of the island of Djerba (Tunisia), without differentiating the urban sites: this is quite a high value. Similarly, the demographic analysis of the Albegna survey by Perkins (1999) provided a value of 19 inhabitants per km² in the countryside.

Finally, another interesting example is *Antium* (Latium) (Attema and De Haas, 2012) where a recent survey carried out by Groningen University registered a density of 17.5 inhabitants per km², taking into account that the territory includes maritime *villae*, which may have been seasonal summer residences. Table 8 summarizes the values of the different surveys and the one census.

If we bear in mind that the scatter dimensions of dwelling units is overestimated in survey demographics, and that a ratio of 20–30 m² per person is probably more accurate, then all the values

5 A site is only recognized when there is a concentration of more than five sherds per m² (Waagen 2014).

6 Most scholars previously accepted a rural density of 24 inhabitants per km² in the hinterland around Rome.

TABLE 8
Densities of rural populations

Regions	Density per km ²	Reference
Rome's hinterland	60 inhabitants	Witcher (2005)
Djerba	30 inhabitants	Fentress (2009)
Albegna valley	19 inhabitants	Perkins (1999)
Antium	17.5 inhabitants	Attema and De Haas (2012)
Roman Spain	10 inhabitants	Atisbuttel (1998)
Roman Spain	7.12 inhabitants	Carreras (2014)
Catalonia	9 inhabitants	Census of 1497

from Rome's hinterland, Djerba, Albegna and *Antium* should be revised and data compared with the numbers provided by historical censuses.⁷

Such methodological difficulties in assigning categories and values to the survey data have been resolved by Laurano (2011) and Hin (2013, 298–341) by using relative values. They compare the number of the same categories of site (similar scatters) for different periods in each *regio* of Roman Italy without attempting to calculate the number of inhabitants. Thereby, as a general trend they conclude that the number of farms increased from the Republic to the Principate by around 34% and the *villae* by almost 68%. Of course, this trend in Roman Italy may have not been matched in other provinces.

In the Iberian peninsula, such high standards in archaeological prospection do not exist as in Italy or Greece, so it becomes difficult to combine data from a wide variety of surveys. Therefore, any selection of surveys reveals more about the state of research rather than offering an accurate approach to ancient demography. In spite of the wide variety of methodologies employed, a map of rural distribution in Hispania (from Augustus to the third century CE) has been generated based on the data from 72 surveys (Carreras 2014). The number of sites ranged from 0.02 to 1.75 per km², which multiplied by a minimum of five people per unit, could provide an approximate overall density per km².

Fig. 7 reveals concentrations of rural populations in the same regions where large cities stood. However, there are so few surveys in the north-east region that it becomes difficult to compare the rural population in Iberian or Roman times with similar data from accurate modern censuses (see Fig. 6).

FINAL REMARKS

Concepts such as community surface (CS), household surface (HS), number of inhabitants per household (IH), and minimum living space (LS) may be universal, though some of their values may change over time. Once those concepts are assumed and applied in an apposite way, it becomes easier to conduct a diachronic study. Here, the methodology was applied to the north-east of the Iberian peninsula from the classical Iberian period (fourth to third centuries BCE) to the early Roman period (first century CE). Most Roman urban populations were already calculated by Carreras (2014), though reckonings of inhabitants in Iberian *oppida* are still incomplete.

⁷ Other calculations for the hinterland of *Neapolis* or Pompeii, as well as the Nile riverside, reached values of 50–150 people per km² (De Simone 2017), which are also high. Some surveys have detected a lack of sites around urban centres, which has been justified by the fact that urban-dwelling citizens may have been the farmers of the surrounding land, in what are called agro-towns (Lo Cascio 2007).

Figure 7
Rural populations from 72 surveys (Carreras 2014, annex 2).

One of the problems that arises when the methodology is applied becomes the presence of small supposed dwellings of less than 10–12 m². Those small spaces cannot hold a standard family of 4–5 members, so it should be assumed that they were occupied by a smaller group (perhaps one or two people) or they may even have had another function altogether, such as storage spaces, stables and so on. However, despite the many uncertainties that still exist, calculations carried out by using this method provide densities per ha for Iberian *oppida* that do not exhibit the high variations seen in previous estimates (see Table 7).

Even though lacking figures for all the urban populations from those two periods (Iberian–Roman), a preliminary comparison can be undertaken for a small area of study. True accuracy will only be achieved by analysing each *oppidum* individually, as we have done for a very few in this article. Today the archaeological data does not allow this approach, especially in the case of the largest and most complex settlements (Belarte 2010, 114–19).

The comparison demonstrates that an urban demographic increase from the late Iberian period into the early Roman one cannot be accepted for this area (Table 9). It is true that the layout of most of these settlements is almost unknown. The existence of an elite that inhabited large houses – something that has been documented at Castellet de Banyoles (Asensio *et al.* 2012, 176–84) and Ullastret (Belarte 2010, 114) – remains likely, at least on those sites with a surface-area of four ha or more. The existence of these large structures, which at Castellet de Banyoles can sometimes attain surface areas of over 200 and 300 m², and even 1000 m² at Ullastret, could potentially considerably

TABLE 9

Comparison of the main Iberian oppida (>4 ha.) populations and the Roman towns in the territory of the Laietani (north-east Spain)

Iberian <i>oppida</i>	ha	Inhabitants	Roman town (Carreras 2014)	ha	Inhabitants
Burriac (Cabrera de Mar)	10	4260	<i>Baetulo</i>	14	3500
El Turó del Montgrós (El Brull)	9	3843	<i>Barcino</i>	12	3000
Puig del Castell de Samalús (Samalús)	4	1704	<i>Blendium</i>	10	2500
La Torre dels Encantats (Arenys de Mar)	4	1704	<i>Iluro</i>	10	2500
Turó de la Rovira (Barcelona)	4	1704	---	---	---
TOTAL	40	13,215	TOTAL	46	11,500

TABLE 10

Comparison of the two main Iberian oppida (>4 ha.) populations and the two main Roman towns in the territory of the Indigetes (north-east Spain)

Iberian <i>oppida</i>	ha	Inhabitants (400/426)	Roman town (Carreras 2014)	ha	Inhabitants
Ullastret	9	3600/3834	<i>Emporiae</i>	21	5250
Illa d'en Reixac	6	2400/2556	<i>Gerunda</i>	6	1500
TOTAL	15	6000/6390	TOTAL	27	6750

reduce the total density. On the other hand, two other factors probably counter-balance this risk of overestimating the population. First, we have applied the minimum density calculated in all our case studies where the archaeological data is quite well preserved (426), and second we have also used the lowest number (4) of inhabitants per household suggested for these types of settlements in our calculations (see Table 3). In addition, when attempts by others to estimate the density of inhabitants per ha for one of these first category *oppida* have been made, as in the case of Ullastret (9 ha), values of 400 inhabitants per ha were established (Sanmartí and Belarte 2001, 167): these are very close to the numbers arrived at by us here.

Secondly, the difference of 1715 persons between the Iberian and Roman projected populations, in favour of the Iberian period, allows for a comfortable margin of error accompanying such estimations, without affecting the claim that an increase in urban population did not take place.

Finally, the 250 inhabitants/ha used to estimate the population of the Roman cities in the area under study correlate well with the numbers known for later periods. Barcelona, of all the Roman urban centres discussed (Table 9) the city that was to have the fastest growth in terms of extent and population during the medieval period, has been assigned an estimated population of 1500 inhabitants (12 ha) in the year 1000 CE (125 inhabitants/ha) and 4000–5000 inhabitants (30 ha) by the end of the eleventh century CE (166.66 inhabitants/ha). It was only subsequently during the twelfth and thirteenth centuries CE (60 and 120 ha respectively) that it reached a population between 10,000 and 12,000 inhabitants (200 inhabitants/ha) in the former case and around 30,000 in the following century (250 inhabitants/ha) (Banks 2005).

Similar dynamics can be seen – although expressed in more fragmentary data – for another Iberian territory in north-east Spain, that occupied by the *Indigetes* and located to the north of the *Laietani*. In this case, the comparison between the two largest urban agglomerations in the Iberian period (Ullastret and l'Illa d'en Reixac) and the main two Roman cities is also quite revealing. As Table 10 shows, the urban population of the two main Iberian settlements might have reached a minimum of 6000 people (3600 of them at Ullastret) compared with the 6750

TABLE 11
Population of other oppida (<4 ha) known in the territory of the Laietani (north-east Spain)

Iberian oppida ¹⁵	ha	Inhabitants (426 inhab./ha)
Olèrdola (Barcelona)	3.5	1491
El Turo d'en Boscà (Badalona)	2	852
Montpalau (Pineda)	2	852
El Turo de Ca n'Olivé (Cerdanyola, Barcelona)	1.5	639
Torre Roja (Caldes de Montbui)	1.5	639
L'Esquerda (Les Masies de Roda de Ter)	1.5	639
Can Bonells (Santa Maria de Merles)	0.8	340
Castellruf (Martorelles,)	0.6	255
La Cadira del Bisbe (Premià de Dalt)	0.6	255
El Turó del Vent (Llinars del Vallès)	0.5	213
El Cogulló (Sallent)	0.4	170
Cellecs (Orrius)	0.36	153
Puig Castellar (Santa Coloma de Gramenet)	0.35	388
La Penya del Moro (Sant Jus tDesvern)	0.3	127
Sant Sebastià de la Guarda (Palafrugell)	0.03	13
Puig Castell (Sant Cebrià de Vallalta)	0.1	42
TOTAL	16.04	7068

estimated for the Roman period. Bearing in mind the exceptional size and importance of the Greek and Roman city of *Emporion/Emporiae* during the late Republican period, a difference of a few hundred individuals does not seem significant. In fact, if we use the minimum density as estimated for our case studies, the difference between the Roman and the Iberian periods will barely reach 300 inhabitants.

To sum up, with minimal give and take, and with the currently available data, it seems quite probable that an urban demographic increase from the late Iberian period into the early Roman one cannot be proposed, either for the territory of the *Indigeti* or for that of the *Laietani*. Given the importance of these two areas, it is quite probable that this constitutes a general trend applicable to most of north-east Spain.⁸

Does this then mean that, contrary to what has always been suggested, the population of *Hispania* decreased from the Iberian to the Roman period? Most likely this was not the case. It probably increased despite the many casualties that occurred during the Second Punic War and the constant subsequent military activity and recruitment. As stated above, the Roman population distribution pattern mirrors an underlying indigenous substrate, rather than one reflecting new Italic urban foundations and new infrastructures. In north-east Spain, where a large number of *ex-novo* foundations are recorded around 80–70 BCE (*Iluro*, *Baetulo*, *Gerunda*, *Emporiae*, *Iesso*, *Auso*, etc.), these new settlements in most cases were built close to the main Iberian *oppida* and, therefore, most likely saw the relocation of the population already inhabiting the same territory during the Iberian period (Figure 2). The key to achieving an accurate comparison is to have numbers for both urban and rural populations.

There are several fully or intensively surveyed territories in north-east Tarraconensis that provide us with some insight into the evolution of the rural population. In the case of the *Ager*

8 The Cossetani territory would require its own detailed study. Due to the extent (70 ha) of the Roman city of *Tarraco*, its status as provincial capital, and a thriving port, which could suggest the existence of apartment blocks (so far not detected), *Tarraco* may represent an exception. Besides, the city spread outside the walls, reaching a total of 80–90 ha in the second century CE (Carreras 2014).

Tarraconensis, the number of late Iberian sites was only 10, whereas this figure increased to 128 in the Republican period, before falling back to 74 during the Principate. Likewise, in the territory of Cossetania only 40 late Iberian rural sites were recorded, while the Roman Republican period registered an increase to 85. These two field surveys appear to record higher occupation of the countryside in Roman times compared to that of the late Iberian period. Obviously this is not that surprising if the population of the ‘non-urban’ *oppida* (listed in Table 11 – for the *Laietani*, which were largely abandoned by the mid-first century BCE) had been resettled over the territory in the transition to the Roman period.

This resettlement can be understood or explained only when interpreted in a wider context that sees the introduction of new political and socioeconomic processes operating on a pan-Mediterranean scale (Tchernia 1986; 2016; Lintott 1993; Temin 2013). The specialization towards viticulture, widely demonstrated archaeologically and by the ancient sources in the littoral territories of north-east Spain, is the material expression of this new economy (Revilla 1995). At the same time, these complex processes cannot be dissociated from the *Pax Romana* that followed the Civil Wars or from the colonization and integration of large territories into the Roman political, legal and administrative provincial system developed by Augustus.

In summary, though we are not in a position to persuasively determine whether there was an increase (and if so, how large it was) in population from the Iberian period to the Roman one in north-east Spain, we are nonetheless able to argue that a concentration of people in the cities is unlikely to have happened: indeed rather the opposite. This is a very important historical conclusion because it reveals that the key to understanding demographic change in north-east Spain from the Iberian to the Roman periods requires a comprehension of the manner of occupation of the rural areas (*ager*), which seem to have been far more intensive and organized under Roman rule.

Acknowledgments

We are especially grateful for the comments and suggestions received from Geoffrey Kron (University of Victoria), Victor Revilla (Universitat de Barcelona) and Ignasi Grau (Universidad de Alicante).

(AGS) *Greek and Roman Studies*
University of Victoria
Clearihue B423, 3800 Finnerty Road
Victoria, BC
CANADA

(Corresponding author) E-mail: agsinner@uvic.ca

(CC) *Ciències de l'Antiguitat i de l'Edat Mitjana, Edifici B Facultat de Filosofia i Lletres 08193*
Bellaterra
Universitat Autònoma de Barcelona
Barcelona
SPAIN

doi: 10.1111/ojoa.12175

REFERENCES

- ALBERCH, R. and CASTELL, N. 1985: *La població de Girona (segles XIV-XX)* (Girona, Monografies, 11).
- ASENSIO, D., CARDONA, R., FERRER, C., GARCIA-DALMAU, C., MORER, J., POU, J. and SAULA, O. 2009: L'arquitectura domèstica en el nucli fortificat ilergeta dels Estincells (Verdú, l'Urgell), Segle III aC. In BELARTE, M.C. (ed.), *L'espai domèstic i l'organització de la societat a la protohistòria de la Mediterrània occidental (Ier millenni aC)* (Barcelona, Arqueo Mediterrània 11), 125–42.
- ASENSIO, D., SANMARTÍ, J., JORNET, R. and MIRÓ, M.T. 2012: L'urbanisme i l'arquitectura domèstica de la ciutat ibèrica del Castellet de Banyoles (Tivissa, Ribera d'Ebre). In BELARTE, M.C., BENAVENTE, J.A., FATÁS, L., DILOLI, J., MORET, P. and NOGUERA, J. (eds.), *Íberos del Ebro. Actas del II Congreso Internacional* (Barcelona), 173–93.
- ATTEMA, P. and DE HAAS, T. 2012: Rural settlement and population extrapolation, a case study from the ager of Antium, central Italy (350 BC–AD 400). In BOWMAN, A. and WILSON, A. (eds.), *Settlement, Urbanization, and Population* (Oxford), 97–140.
- AÜSBUTTEL, F.M. 1998: *Die Verwaltung des Römischen Kaiserreiches. Von der Herrschaft des Augustus bis zum Niedergang des Weströmischen Reiches* (Darmstadt).
- BAGNALL, R.S. and FRIER, B.W. 1994: *The Demography of Roman Egypt* (Cambridge).
- BANKS, P. 2005: El creixement físic de Barcelona, segles x–xiii. *Quaderns d'Història* 8, 11–33.
- BELARTE, M.C. 2010: Los individuos en el espacio doméstico en la protohistoria de Cataluña. *Arqueología Espacial* 28, 109–34.
- BOWMAN, A. and WILSON, A. (eds.) 2009: *Settlement, Urbanization, and Population* (Oxford).
- CARRERAS, C. 1996: Una nueva perspectiva para el estudio demográfico de la Hispania romana. *Boletín del Seminario de Estudios de Arte y Arqueología* 62, 95–122.
- CARRERAS, C. 2014: Nuevas tendencias y datos sobre la demografía romana en la Península Ibérica. *Boletín del Seminario de Estudios de Arte y Arqueología* LXXX, 53–82.
- CORVISIER, J.N. and SUDER, W. 2000: *La population de l'antiquité classique* (Paris).
- CONVENTI, M. 2004: *Città romane di Fondazione* (Rome).
- DE LIGT, L. 2012: *Peasants, Citizens and Soldiers: Studies in the Demographic History of Roman Italy, 225 BC – AD 100* (Cambridge).
- DE SIMONE, F. 2017: The agricultural economy of Pompeii: surplus and dependence. In FLOHR, M. and WILSON, A. (eds.), *The Economy of Pompeii* (Oxford), 53–86.
- DEDET, B. 1987: *Habitat et vie quotidienne en Languedoc au milieu de l'âge du Fer. L'unité domestique n° 1 de Gailhan, Gard* (Paris, Rev. Arch. Narbonnaise Suppl. 7).
- DEDET, B. 1999: La maison de l'oppidum languedocien durant la Protohistoire: forme et utilisation de l'espace. *Gallia* 56, 313–55.
- DEVORE, J. L. 2012: *Probability and Statistics for Engineering and the Sciences* (Portland).
- FENTRESS, E. 2009: Peopling the countryside: Roman demography in the Albegna Valley and Jerba. In BOWMAN, A. and WILSON, A. (eds.), *Settlement, Urbanization, and Population* (Oxford), 127–61.
- FLOHR, M. 2017: Quantifying Pompeii: population, inequality, and the urban economy. In FLOHR, M. and WILSON, A. (eds.), *The Economy of Pompeii* (Oxford), 53–86.
- GARCÍA MERINO, C. 1976: *Población y poblamiento en Hispania romana: el Conventus Cluniensis* (Valladolid).
- GOZALBES, E. 2007: La demografía de la Hispania romana tres décadas después. *Historia Antiqua* XXXI, 181–208.
- GRACIA, F., MUNILLA, G., GARCÍA, E., PLAYA, R. M. and MURIEL, S. 1996: Demografía y superficie de poblamiento en los asentamientos ibéricos del NE peninsular. *Complutum Extra* 6(11), 177–91.
- GRAU, I. 2014: The Iron Age landscape of Alcoi valley, eastern Iberia: agricultural intensification and sociopolitical dynamics. *Journal of Field Archaeology* 39(2), 124–33.
- GUERIN, P. 2003: *El Castellet de Bernabé y el horizonte ibérico pleno edetano* (Valencia).
- HANSEN, M.H. 2006: *The Shotgun Method: the Demography of the Ancient Greek City-state Culture* (Columbia).
- HANSON, J.W. 2016: *An Urban Geography of the Roman World, 100 B.C. to A.D. 300* (Oxford).
- HANSON, J.W. and ORTMAN, S.G. 2017: A systematic method for estimating the population of Greek and Roman settlements. *Journal of Roman Archaeology* 30, 301–24.
- HASSAN, J.F. 1981: *Demographic Archaeology* (New York).
- HILL, J.N. 1970: *Broken K Pueblo. Prehistoric Social Organization in the American Southwest*. (Tucson).

- HIN, S. 2013: *The Demography of Roman Italy. Population Dynamics in an Ancient Conquest Society. 201 BCE–14 AC* (Cambridge).
- IGLESIAS, J. 1962: *El fogaje de 1365-1370. Contribución al conocimiento de la población de Cataluña en la segunda mitad del siglo XIV* (Barcelona).
- IGLESIAS, J. 1979: *El fogatge de 1553* (Barcelona).
- IGLESIAS, J. 1981: *El fogatge de 1553. Estudi i transcripció* (Barcelona).
- IGLESIAS, J. 1991: *El fogatge de 1497 Estudi i transcripció* (Barcelona).
- ISOARDI, D. 2012: Demographic analysis of the pre-Roman population near the Greek colony of Massalia (Southern France). In HERMARY, A. and TSETSKHLADZE, G.R. (eds.), *From the Pillars of Hercules to the Footsteps of the Argonauts* (Leiden), 37–60.
- ISOARDI, D. 2009: L'apport des données démographiques dans une étude de l'organisation de la société préromaine de France méridionale. Une nouvelle lecture des oppida. In BELARTE, M.C. (ed.), *L'espai domèstic i l'organització de la societat a la protohistòria de la Mediterrània occidental (1er millenni aC). Actes de la IV Reunió internacional d'Arqueologia de Calafell (Calafell-Tarragona, 6 al 9 de març de 2007)*. Arqueo Mediterrania 11, 67–77.
- KENNEDY, D. 2006: Demography, the population of Syria, and the census of Q. Aemilius Secundus. *Levant* 38, 109–24.
- KRON, G. 2005: The Augustan census figures and the population of Italy. *Athenaeum* 93, 441–95.
- KRON, G. 2017: The population of Northern Italy and the debate over the Augustan census figures: weighing the documentary, literary, and archaeological evidence. In LO CASCIO, E. and MAIURO, M. (eds.), *Popolazione e risorse nell'Italia settentrionale dall'età preromana ai Longobardi* (Bari), 49–98.
- LAUNARO, A. 2011: *Peasants and Slaves. The Rural Population of Roman Italy (200 BC to AD 100)* (Cambridge).
- LEBLANC, S. 1971: An addition to Naroll's suggested floor area and settlement population relationship. *American Antiquity* 36(2), 210–11.
- LINTOTT, A. 1993: *Imperium Romanum: Politics and Administration* (New York).
- LO CASCIO, E. 2007: The early Roman Empire: the state and the economy. In SCHEIDEL, W., MORRIS, I. and SALLER, R. (eds.), *The Cambridge Economic History of the Greco-Roman World* (Cambridge), 619–47.
- MCINTYRE, L.J. 2015: Reconstructing population size in the Romano-British colonia: the case of Eboracum. *Journal of Roman Archaeology* 28, 413–29.
- MILLETT, M. 1990: *The Romanization of Britain* (Cambridge).
- MORLEY, N. 1996: *Metropolis and Hinterland: the City of Rome and the Italian Economy 200 B.C.–A.D. 200* (Cambridge).
- NAROLL, R. 1962: Floor area and settlement population. *American Antiquity* 27, 287–9.
- NEUSTUPNY, E. 1983: The demography of prehistoric cemeteries. *Pamatky Archeologické* 74, 7–34.
- PERKINS, P. 1999: *Etruscan Settlement, Society and Material Culture in Central Coastal Etruria* (Oxford).
- PY, M. 1996: Les maisons protohistoriques de Lattara (IVe–Ier s. av. n.è.), approche typologique et fonctionnelle. *Lattara* 6, 141–258.
- REVILLA, V. 1995: *Producción cerámica, viticultura y propiedad rural en Hispania Tarraconensis. (siglos I aC–III dC.)* (Barcelona).
- SALRACH, J.M. 1982: *Història dels Països Catalans: Dels orígens a 1714* (Barcelona).
- SANMARTÍ, J. and BELARTE, C. 2001: Urbanización y desarrollo de estructuras estatales en la costa de Cataluña. In BERROCAL-RANGEL, L. and GARDES, P. (eds.), *Entre celtas e iberos. Las poblaciones protohistóricas de las Galias e Hispania* (Madrid), 161–74.
- SCHEIDEL, W. 1996: Measuring Sex, Age and Death in the Roman Empire: Explorations in Ancient Demography (Ann Arbor).
- STEWART, J.H. 1937: Ecological aspects of Southwestern society. *Anthropos* 32, 87–104.
- STOREY, G.R. 1997: The population of ancient Rome. *Antiquity* 71, 966–78.
- TCHERNIA, A. 1986: *Le vin de l'Italie romaine: essai d'histoire économique d'après les amphores* (Rome).
- TCHERNIA, A. 2016: *The Romans and Trade* (Oxford and New York).
- TEMIN, P. 2013: *The Roman Market Economy* (Princeton).
- TUMER, CH. G. and LOFGREN, L. 1966: Household size of prehistoric Western Pueblo Indians. *Southwestern Journal of Anthropology* 22, 117–32.
- WAAGEN J. 2014: Evaluating background noise: assessing off-site data from field surveys around the Italic sanctuary of S. Giovanni in Galdo, Molise, Italy. *Journal of Field Archaeology* 39(4), 417–29.

- WALLACE-HADRILL, A. 1994: *Houses and Society in Pompeii and Herculaneum* (Princeton).
- WELLS, P.S. 1984: *Farms, Villages and Cities. Commerce and Urban Origins in Late Prehistoric Europe* (Ithaca).
- WITCHER, R. 2005: The extended metropolis: urbs, suburbium and population. *Journal of Roman Archaeology* 18, 120–38.
- ZORN, J. 1994: Estimating the population size of ancient settlements: methods, problems, solutions, and a case study. *BASOR* 295, 31–48.