

Making and Meaning in the Bronze and Iron Ages

Chronology, Landscapes
and Societies across Europe

Edited by
Lucía Ruano Posada, Dirk Brandherm
and Luis Berrocal-Rangel



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Editors' Foreword

The present volume, *Making and Meaning in the Bronze and Iron Ages: Chronology, Landscapes and Societies across Europe*, brings together a selection of papers presented at METALAGES2024 – *Chronological Methods and their Correlation in the Metal Ages*, held in Florence in October 2024. Co-organized by the UISPP Scientific Commission *Metal Ages in Europe and the Mediterranean* and the *Istituto Italiano di Preistoria e Protostoria*, the colloquium provided a platform for researchers across Europe and the Mediterranean to share new chronological data, methodological reflections, and interpretative insights into the societies of the Metal Ages.

While the thematic axis of the conference was dedicated to questions of chronology—its scientific foundations, its diverse applications, and the perennial challenge of correlating relative, absolute, and historical frameworks—this volume also reflects the breadth of work unfolding across the field. The papers gathered here capture not only advances in dating methods and typological studies, but also the richness of current archaeological practice, from the reconstruction of settlement networks and craft economies to the social meanings of material culture and personhood.

Chronological frameworks remain the structural backbone of prehistoric archaeology. Over the past decades, new tools—radiocarbon dating, dendrochronology, Bayesian modelling, and isotopic analyses among them—have refined our temporal understanding to an unprecedented degree. Yet, as the discussions in Florence reminded us, these advances invite as many questions as they resolve. Aligning laboratory chronologies with typological sequences and regional cultural schemes is not a straightforward process. Nor can the calibration of time be separated from broader interpretative debates about the tempo of change, human agency, and cultural connectivity. This volume thus situates itself at the intersection between technical precision and interpretative synthesis, where chronology becomes more than a scaffold for history—it becomes a field of inquiry in its own right.

At the same time, the contributions from the general session—reflected in the majority of papers in this volume—demonstrate the vitality and diversity of current research on the Bronze and Iron Ages. Studies included here span a wide geographical and thematic range: from gender and personhood in prehistoric societies to fortifications in Austria and coastal or submerged sites in Western Europe, and from the Mediterranean networks that shaped Iberian and Sicilian communities to the craftspeople whose work sustained ancient economies. Together, they highlight how questions of making—material production, landscape engagement, and cultural expression—intersect with those of meaning, the symbolic and social dimensions that give archaeological remains their interpretative depth.

In uniting these perspectives, *Making and Meaning in the Bronze and Iron Ages* reflects the spirit of the METALAGES colloquium series: collaborative, interdisciplinary, and grounded in the shared conviction that technical and theoretical advances must move hand in hand. As such, the editors hope that this collection not only captures a moment in current research, but also encourages new conversations across the boundaries of method, region, and discipline.

Lucía Ruano Posada, Dirk Brandherm and Luis Berrocal-Rangel

**Thematic Session:
Chronological Methods and their
Correlation in the Metal Ages**

La cronologia dell'antica età del Bronzo tra Lombardia orientale e Veneto occidentale: dalle datazioni assolute dendrocronologiche e radiocarboniche alla tipocronologia dei materiali

Marco Baioni,¹ Federica Gonzato,² Cristina Longhi,³ Claudia Mangani⁴ and Nicoletta Martinelli⁵

Abstract

In recent decades, numerous studies have been conducted in the area under examination, yielding a considerable amount of chronological data concerning the Early Bronze Age, a period in which the area was involved in the so-called pile-dwelling phenomenon. The presence of wetland sites has led to the formation of an interesting corpus of dendrochronological dates, which have long made it possible to develop station sequences, some fluctuating and others dated absolutely with wiggle-matches. Numerous radiocarbon dates are available from contexts always linked to the Polada Culture, both in wet and dry environments. This circumstance allows us to expand the contexts provided with absolute dating, even if it is not always easy to relate the two systems. Another important issue is to define a clear correlation between the stratigraphic sequences and therefore the archaeological materials and the dates linked to the vertical wooden structures. In fact, this is not possible in all contexts due to the absence of stratigraphic markers. The excavation of numerous archaeological contexts has made available a large number of materials susceptible to typological-chronological analysis, which has made it possible to identify numerous horizons. A careful study of the evolutionary dynamics of Polada Culture pottery seems to show a continuous evolution over time with slight changes in the percentage of the various types. To complicate the picture, it can be said that the structural breaks identified in the various settlements do not always coincide from a chronological point of view.

Key words: Early Bronze Age, dendrochronology, radiocarbon, sequences, chronology

Sommario

Nel territorio preso in esame negli ultimi decenni sono state avviate numerose ricerche che hanno portato a un notevole numero di dati di interesse cronologico riguardanti l'antica età del Bronzo, epoca in cui l'area è coinvolta nel cosiddetto fenomeno palafitticolo. La presenza di siti di ambiente umido ha portato alla formazione di un interessante corpus di datazioni dendrocronologiche che hanno consentito da tempo di elaborare sequenze stazionali, alcune fluttuanti altre datate in modo assoluto con wiggle-matches. Da contesti sempre legati alla Cultura di Polada, sia di ambiente umido sia di ambiente asciutto, sono a disposizione numerose datazioni radiocarboniche. Questa circostanza consente di ampliare i contesti forniti di datazione assoluta, anche se non è sempre agevole mettere in relazione i due sistemi. Altra questione importante è definire una correlazione netta tra le sequenze stratigrafiche e quindi i materiali archeologici e le datazioni legate alle strutture lignee verticali. Infatti, non in tutti i contesti questo è possibile per l'assenza di marker stratigrafici. Lo scavo di numerosi contesti archeologici ha poi reso disponibile un gran numero di materiali suscettibili all'analisi tipocronologica che ha consentito di individuare numerosi orizzonti. Uno studio accurato delle dinamiche evolutive della ceramica della Cultura di Polada sembra mostrare un'evoluzione continua nel tempo con leggere modifiche nella percentuale dei vari tipi. A complicare il quadro si può affermare che le cesure strutturali individuate nei vari abitati non sempre coincidono dal punto di vista cronologico.

Parole chiave: Bronzo Antico, dendrocronologia, radiocarbonio, sequenze, cronologia

Nel territorio preso in esame, che corrisponde all'area del Garda e del suo anfiteatro morenico e al tratto di pianura padana circostante, appartenente alle province di Brescia, Cremona, Mantova e Verona, negli ultimi decenni sono state avviate numerose ricerche che hanno portato a un notevole numero di dati di interesse cronologico riguardanti l'antica età del Bronzo, epoca in cui l'area è coinvolta nel cosiddetto fenomeno palafitticolo.

¹ Museo Archeologico della Valle Sabbia – Gavardo (BS); marco.baioni.archeologo@gmail.com

² Soprintendenza ABAP delle province di Ravenna, Forlì-Cesena e Rimini; federica.gonzato@cultura.gov.it

³ Soprintendenza ABAP delle province di Bergamo e Brescia; cristina.longhi@cultura.gov.it

⁴ Museo Civico Archeologico “G. Rambotti” – Desenzano del Garda (BS); 36claudia36@gmail.com

⁵ Laboratorio Dendrodata; nicoletta.martinelli@dendrodata.it

In questo modo si sono venute a determinare condizioni che potrebbero essere molto favorevoli a una buona strutturazione cronologica del Bronzo Antico. Innanzitutto la decisa presenza di siti di ambiente umido, che conservano strutture in legno, molto spesso di quercia, ha portato alla formazione di un interessante corpus di datazioni dendrocronologiche che hanno consentito da tempo di elaborare cronologie regionali e sequenze stazionali, alcune fluttuanti e altre datate in modo assoluto con *wiggle-matches*, che coinvolgono e mettono in relazione su scala cronologica annuale diversi siti. In secondo luogo, sono a disposizione numerose datazioni radiocarboniche, provenienti da campioni in legno, carbone e osso prelevati in contesti sempre legati alla Cultura di Polada, sia di ambiente umido che di ambiente asciutto (abitati non palafitticoli, grotte, necropoli). Infine si registra, nel grande numero di siti noti, la disponibilità di un certo numero di siti scavati con metodo stratigrafico con presenza di alcune sequenze stratigrafiche affidabili.

Scopo di questo intervento è di analizzare lo stato di questi tre fattori ed evidenziarne i punti di forza e, soprattutto, i punti di debolezza che, nonostante le premesse favorevoli, creano forti limitazioni nella ricostruzione di un coerente quadro cronologico.

Dendrocronologia

L'area del Garda è stato il primo comprensorio ad essere oggetto di un programma di ricerca finalizzato alla datazione dendrocronologica da parte del Laboratorio di Dendrocronologia del Museo Civico di Storia Naturale di Verona e poi dall'Istituto Italiano di Dendrocronologia e dal Laboratorio Dendrodata di Verona (Fasani e Martinelli 1996; Martinelli 1996). Attualmente si hanno a disposizione datazioni dendrocronologiche per oltre una ventina di siti (Martinelli 2020, 2022a). La quasi totalità delle datazioni è stata effettuata su campioni di quercia caducifolia, il legno più utilizzato per le strutture verticali portanti nei villaggi palafitticoli dell'Italia settentrionale, con significativa eccezione dei due siti trentini di Fiaivè e Ledro dove gli elementi verticali sono in conifera (Martinelli 2022b).

Le datazioni ottenute sono particolarmente importanti poiché evidenziano le fasi edilizie di questi abitati, anche se a volte è difficile attraverso la dendrocronologia datare eventi di altra natura, come ad esempio le interruzioni nell'insediamento e la distruzione dei siti.

Altra questione importante è definire una correlazione netta tra le sequenze stratigrafiche e quindi le fasi di cronologia relativa con le loro caratteristiche tipocronologiche e le datazioni legate alle strutture lignee verticali. Infatti, non in tutti i contesti questo è possibile per l'assenza di marker stratigrafici netti e per la presenza di episodi di abbattimento molto più numerosi delle fasi insediative riconosciute (de Marinis 2022; Martinelli 2022a).

A questo proposito sono particolarmente importanti le datazioni effettuate su elementi lignei orizzontali, anche se è fondamentale definire le loro modalità di giacitura, in particolare se si tratta di elementi orizzontali in situ (come i plinti) o di elementi caduti dalle strutture, oppure defunzionalizzati e gettati intenzionalmente.⁶

Di fondamentale importanza per la datazione dei contesti gardesani è la presenza di alcune sequenze regionali fluttuanti, datate con *wiggle-matches*. Si tratta soprattutto delle curve elaborate da Nicoletta Martinelli: GARDA 1, suddivisa in due parti rispettivamente di 309 anni (2204–1896 cal BC) e 165 anni (1993–1829 cal BC) e di GARDA 3 lunga 220 anni (1897–1678 cal BC). Le due sequenze di GARDA 1 sembrerebbero sovrapporsi per circa 100 anni, ma non è stato ancora possibile validare statisticamente la loro sincronizzazione (Martinelli 2007, 2022a).

Per il Bronzo Antico le uniche datazioni indipendenti da questo sistema cronologico sono quelle realizzate dal gruppo di Carol Griggs, Peter Kuniholm e Maryanne Newton per il Lavagnone (Griggs *et al.* 2007). A

⁶ Al Lucone, sito D, sono noti i casi di elementi datati cronologicamente alla prima fase dell'abitato, buttati all'inizio della seconda fase, probabilmente durante la ristrutturazione delle case dopo l'incendio (Baioni *et al.* 2022).

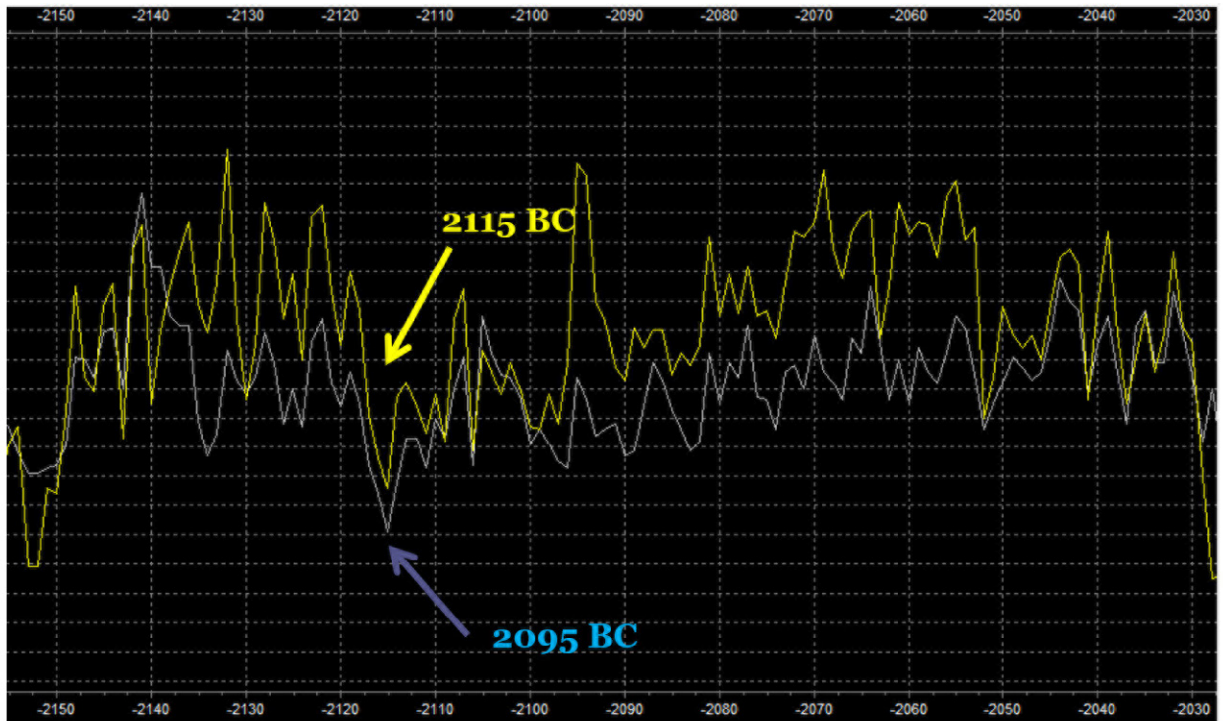


Figura 1. Curva dendrocronologica del Lavagnone confrontata con la curva GARDA 1, su cui sono evidenziati l'anello preso ad esempio e le due differenti datazioni derivanti dai due *wiggle matches* indipendenti.

questo proposito bisogna ribadire quanto già espresso nel 2007, riguardo alle modalità di confronto su scala di precisione annuale tra le date ottenute per il Lavagnone e le date degli altri 13 siti della regione facenti parte della cronologia regionale GARDA 1, nella nuova versione elaborata presso il Laboratorio Dendrodata (Martinelli 2007: 109, nota 11; Martinelli 2020).

Come noto, una prima curva stazionale per il Lavagnone è stata elaborata da Martinelli nel 1994, con datazione assoluta ottenuta dall'inserimento nella cronologia GARDA 1, datata col metodo del *wiggle-matching* (Martinelli 1996). Successivamente è stata elaborata la nuova curva stazionale del sito da parte dell'equipe di Kuniholm della Cornell University, datata in modo indipendente attraverso l'elaborazione di un altro *wiggle-match* e pubblicata nel 2007 (Griggs *et al.* 2007).

Le due serie del Lavagnone in realtà si sincronizzano perfettamente solo che il *mid-point* ottenuto dalle due elaborazioni indipendenti sulla curva di calibrazione risulta spostato di 20 anni. Questa differenza può risultare di più chiara comprensione se prendiamo come punto di riferimento un anello ben identificabile per essere un minimo caratteristico, cioè un anello più stretto nella quasi totalità dei campioni indagati (Figura 1): si nota come esso corrisponda all'anno 2115 BC nella cronologia Dendrodata e al 2095 BC nella curva dell'Università di Ithaca. Si badi bene, lo scarto deriva da due elaborazioni statistiche indipendenti, il cui risultato rientra comunque entro l'intervallo di errore definito per entrambe al 95% di probabilità. Se si vuole confrontare le due sequenze, tuttavia è necessario che le nuove date del Lavagnone siano 'invecchiate' di 20 anni, solo così si potrà mantenere la scala cronologica annuale di confronto con gli altri siti.

Per l'area indagata al Lucone D le fasi insediative possono essere riconosciute non solo su base stratigrafica, ma anche costruttiva, la dendrocronologia, infatti, non solo porta alla datazione assoluta, ma, riconoscendo i pali tra loro contemporanei, consente di identificare le diverse operazioni di abbattimento e quindi spesso di ricostruire la planimetria delle case e la storia dell'evoluzione del villaggio.

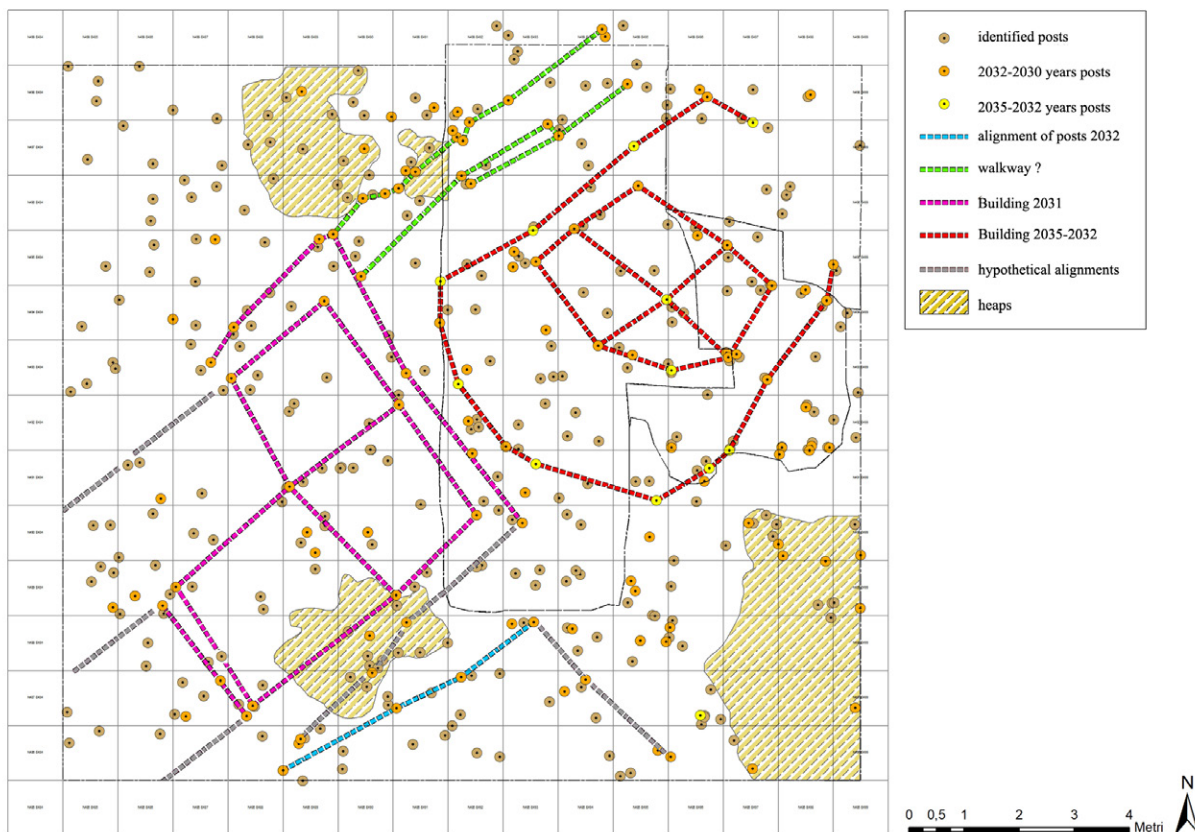


Figura 2. Lucone di Polpenazze (BS). Ipotesi ricostruttiva del Settore 1 del Lucone D – fase LUD1a, ricavata dalle datazioni dendrocronologiche, con in evidenza la struttura più antica (in rosso) e la struttura più grande e recente (viola) con annessa passerella (in verde).

Passiamo ora a considerare il caso dei nuovi scavi al Lucone. Nella prima fase del Lucone D, detta LUD1, le misurazioni dendrocronologiche hanno portato a definire un primo intervento di costruzione del villaggio partito intorno al 2034 BC e durato qualche anno. Le datazioni dendrocronologiche e le osservazioni dendrotipologiche hanno consentito di distinguere una struttura più antica, di dimensioni contenute e di forma quadrangolare, edificata con legno ottenuto da alberi abbattuti tra il 2035 e il 2032, e una struttura più grande, al confine tra il settore 1 e il settore 2, poco più recente ottenuta da pali con abbattimento al 2031, probabilmente connessa con una passerella datata tra il 2032 e 2030. Ne è stato possibile sinora rintracciare 3 moduli completi di circa 2,5 m di lato, riconducibili a una struttura del tipo a pali centrali e conseguenti due navate (Figura 2).

L'esistenza di moltissimi elementi con datazione dell'abbattimento avvenuta in anni immediatamente consecutivi (ad esempio nei periodi 2034–2030 o 2020–2016) ha reso necessario il ricorso alla dendrotipologia, tecnica che definisce le caratteristiche della zona boschiva di provenienza degli alberi e consente di rintracciare non solo gli elementi contemporanei, ma quelli provenienti dalla medesima zona forestale, pertinenti al medesimo intervento di approvvigionamento. La medesima tecnica ha evidenziato lo sfruttamento di un bosco ad alta densità quasi del tutto naturale, sorto però a seguito di una rigenerazione spontanea dopo un episodio di deforestazione, databile circa a 120 anni dall'insediamento del villaggio (Martinelli 2017). Ad accrescere la complessità della ricostruzione si deve segnalare la probabile pratica di uno stoccaggio di breve durata del legname.

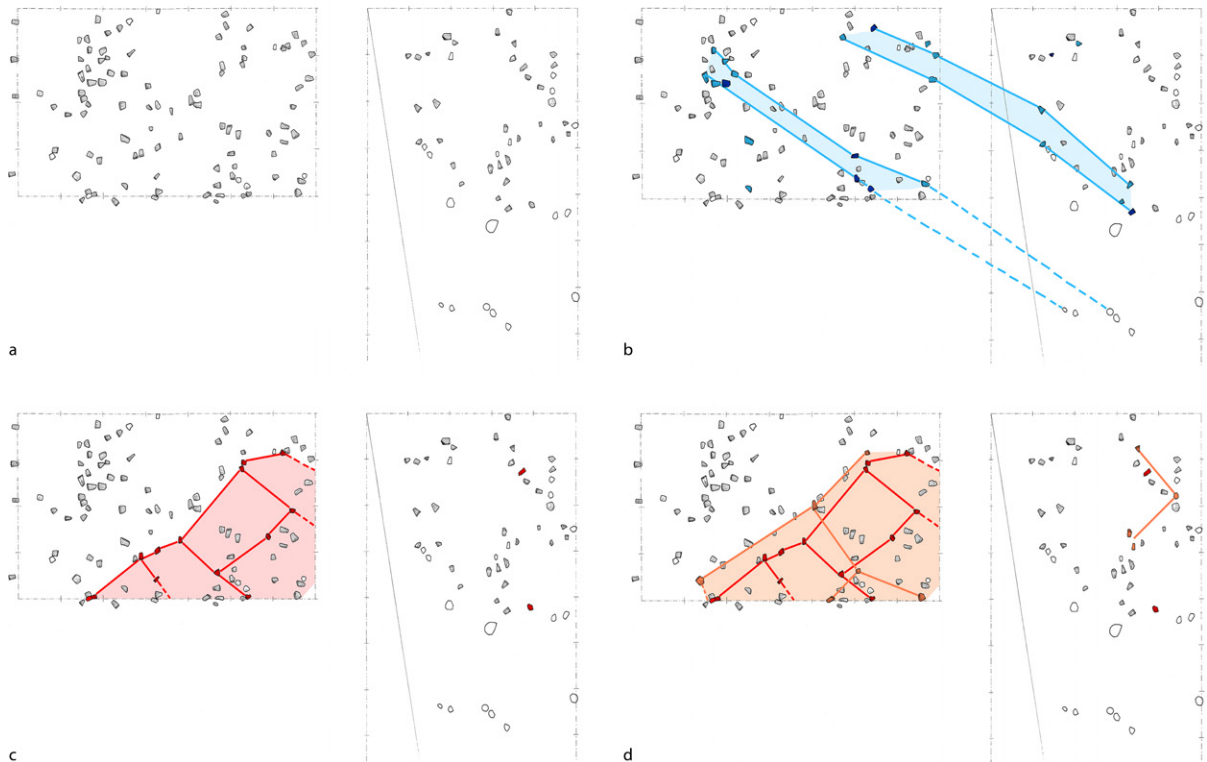


Figura 3. Bande di Cavriana (MN) – ricostruzione della planimetria delle strutture su base dendrocronologica; a) ricostruzione del posizionamento dei pali a livello di inflessione, estrapolata dal raddrizzamento dei pali inclinati, nelle aree di scavo 1981 (a destra) e 1983 (a sinistra); b) identificazione delle passerelle impiantate fra gli anni 1999 e 1994 cal BC; c) identificazione dei pali portanti un edificio, probabilmente abitativo, edificato nel 1980 cal BC; d) identificazione dei pali relativi a una probabile ristrutturazione dell'edificio, impiantati nel 1974 cal BC (elaborazione di N. Martinelli, grafica di E. Cavallo).

L'abitato del Lucone D presenta l'ultimo abbattimento individuato al 1967 BC e dunque l'attività costruttiva è durata circa 70 anni e la vita complessiva del villaggio D difficilmente avrà superato il secolo (Baioni *et al.* 2021a, 2021b, 2022, 2025).

In questo lasso di tempo il villaggio ha subito un esteso incendio ed è stato ricostruito. La datazione dell'incendio è però una questione complessa poiché, mentre è ben chiara l'attività edilizia di impianto che si concentra tra il 2034 e il 2030, definita non solo sulla base delle datazioni, ma anche dall'individuazione delle strutture, successivamente sono stati individuati 27 diversi abbattimenti distribuiti nel tempo che sembrano appartenere più a un'ordinaria manutenzione che a una ricostruzione completa del villaggio. Il tentativo di datare l'incendio e il momento di abbandono del sito con datazioni radiocarboniche di materiali di vita breve non ha dato i risultati sperati poiché l'intervallo cronologico ottenuto dalla calibrazione delle date è risultato troppo ampio a causa dei caratteri della curva di calibrazione per il periodo di vita del villaggio (Martinelli 2022c).

Si è dunque adottata una strategia che, pur non consentendo una massima precisione, può aiutare ad approssimare la data presunta: si sta procedendo alla datazione progressiva con la dendrocronologia di tutti gli elementi lignei orizzontali coinvolti nel crollo provocato dall'incendio per arrivare a un'ipotetica data post quem. Finora l'elemento ligneo più recente coinvolto nell'incendio si data al 2017 BC, anno dopo il quale si registra un leggero aumento di abbattimenti di pali verticali (Baioni *et al.* 2022: 481).

Ulteriori informazioni sono emerse dallo studio dei pali con serie brevi di anelli. Infatti l'analisi dendrocronologica e dendrotipologica di questi elementi ricavati da legno 'giovane' non solo ha consentito

di definire meglio le modalità di sfruttamento del bosco, ma anche di delineare una probabile successiva fase di abbattimento databile tra i 2 e i 14 anni dopo l'ultima fase finora definita (1967 BC). Una fase legata forse agli ultimi tentativi di ristrutturazione con piccoli pali prima del definitivo abbandono, forse legato all'indisponibilità di materiale ligneo di qualità (Capano *et al.* 2020).

Anche a Bande di Cavriana (Figura 3), scavi Piccoli 1981–1983 (Piccoli 1982, 1986) le datazioni dendrocronologiche hanno consentito di riconoscere diverse fasi costruttive: in una delle prime fasi (1999–1994 BC) sono stati individuati elementi portanti di camminamenti e successivamente (1980) è stata realizzata una struttura abitativa, purtroppo non visibile nella sua interezza all'interno del saggio, che solo qualche anno più tardi veniva ristrutturata (1974) (Baioni *et al.* 2018). Per Bande di Cavriana l'analisi dendrotipologica ha evidenziato modalità parzialmente diverse di sfruttamento della copertura forestale (Martinelli 2017).

Le datazioni ¹⁴C

Per il Bronzo Antico gardesano sono disponibili oltre un centinaio di datazioni radiocarboniche, che però presentano vario grado di affidabilità (Guidi *et al.* 1996; Skeates 1994). Alcune sono misurazioni piuttosto vecchie, non pubblicate con tutte le informazioni ora ritenute indispensabili per l'igiene cronometrica. Spesso, dunque, non si hanno informazioni riguardanti il materiale su cui è stata eseguita la datazione.

Recentemente sono state edite e sono state utilizzate per l'elaborazione di modelli bayesiani varie date di importanti contesti databili al Bronzo Antico ma in ambiente asciutto, come Monte Covolo (Rapi 2013) o la necropoli di Arano (Valzolgher *et al.* 2012).

Sono state raccolte in occasione di un convegno ad Halle tutte le date edite comprese tra la fine dell'età del Rame e la prima fase dell'età del Bronzo, suddivise in tre fasi (fine età del Rame, Campaniforme e prima fase età del Bronzo) sulla base dei materiali archeologici ad esse correlati. L'elaborazione delle Boundaries di queste tre fasi ha evidenziato una parziale sovrapposizione tra la fine dell'età del Rame e l'antica età del Bronzo, mentre le due Boundaries calcolate per il Campaniforme risultano estremamente ampie, tanto da superare quelle delle altre due fasi. Interessante comunque è che il *Boundary Start* della prima fase dell'età del Bronzo cade nell'intervallo di tempo tra il 2253 e il 2146 cal BC che risulta più antico (Figura 4) dell'esplosione del fenomeno palafitticolo (Leonardi *et al.* 2015).

Nuove datazioni sono risultate disponibili per siti della Cultura di Polada in grotta (Grone) e per necropoli (Asola). Nel primo caso si tratta di un contesto culturale che ha restituito forme ceramiche particolari che però trovano alcuni rimandi nel Bronzo antico iniziale. Le analisi radiocarboniche condotte su un campione di legno⁷ hanno fornito una datazione cal 2σ 2580 BC (95.4%) – 2300 BC; un'ulteriore datazione, cal 2σ 2210–2022 BC (92%), è stata ottenuta da una cariosside di orzo.

Per Asola le nuove date posizionano questa interessante necropoli con scheletri rannicchiati deposti con diverso orientamento a secondo del genere tra il 1980 e il 1730 cal BC.⁸ Quasi tutte queste determinazioni sono state elaborate con la curva di calibrazione IntCal93, che tuttavia non mostra grandi variazioni rispetto a IntCal20 in questi secoli.

La presenza di queste datazioni ha consentito di ampliare i contesti forniti di datazione assoluta, anche se non è sempre agevole mettere in relazione i due sistemi, in considerazione dell'alta precisione delle date dendrocronologiche in relazione alle radiocarboniche che risentono delle particolari caratteristiche delle curve di calibrazione tra 3600 e 3500 BP.

⁷ US 8, quad. I3. Analisi effettuata dal CEDAD dell'Università del Salento nel 2016 (campione 3, LTL16087a). Radiocarbon Age (BP) 3963 ± 45 .

⁸ Si tratta solo di due date che, dato l'ampio range di calibrazione, non consentono di collocare nel tempo con precisione questa interessante necropoli dai manufatti di aspetto piuttosto arcaico. Si fa presente che i manufatti in metallo sono risultati tutti in rame ridotto da Fahlerz (analisi Giardino) (Baioni 2001).

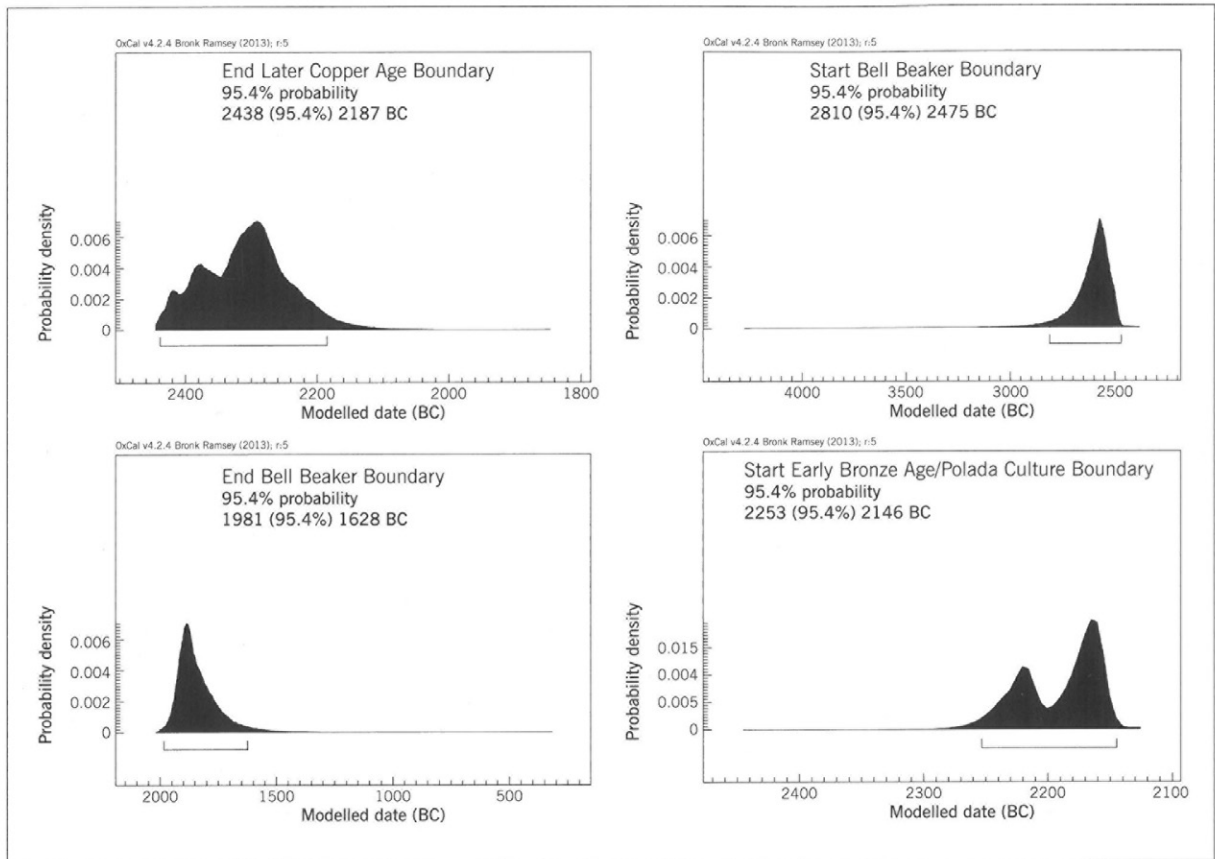


Figura 4. Date stimate dei Boundaries tra le tre fasi prese in esame dal modello Bayesiano. Sono riportati i risultati per le Boundaries 'Fine dell'età del Rame' (End Copper Age), 'Inizio Campaniforme' (Start Bell Beaker), 'Fine Campaniforme' (End Bell Beaker) e 'inizio Antica età del Bronzo/Cultura di Polada' (Start Early Bronze Age/Polada Culture (da Leonardi *et al.* 2015).

Sequenze e contesti stratigrafici sicuri

A fronte di un numero considerevole di siti dell'età del Bronzo presenti nell'area in studio (circa 100), non sono molte le sequenze stratigrafiche di riferimento e i contesti di scavo sicuro. Molti siti infatti sono noti per raccolte di superficie, altri per scavi operati con metodologie superate e infine si segnala la presenza di un certo numero di scavi, anche datati, che attendono ancora una pubblicazione esaustiva.

Esistono innanzitutto alcuni siti all'asciutto che presentano sequenze di interesse cronologico a livello regionale. Alle pendici del colle del Lazzaretto a Love (BG) si è accumulata una stratigrafia in deposizione secondaria, dovuta ai butti caduti dalla sommità del colle che era occupata da un abitato di lunga durata, fondato nel Tardo Neolitico e frequentato fino al Bronzo Finale (Figura 5). Per quanto riguarda il periodo che ci interessa, è documentata una sequenza di tre differenti strati: un livello antico che presenta ancora elementi campaniformi, accanto a materiali a cordoni lisci e prese triangolari (US 34). Segue uno strato con materiali simili, ma privo di elementi campaniformi, sostituiti da forme già pienamente poladiane (US 33) (Figura 6). In questo strato è presente una tavoletta enigmatica (Poggiani Keller 2000: fig. 41). Infine è presente uno strato con elementi tipici delle fasi tarde della Cultura di Polada (US 30), come due scodelloni con decorazione cruciforme (Leonardi *et al.* 2015; Poggiani Keller 2000). L'unica datazione radiometrica disponibile proviene dallo strato inferiore (US 34) e si colloca in una fase centrale del Bronzo Antico: 3560 ± 40 BP, cal BC 1s 1960–1870 (GX 26851).

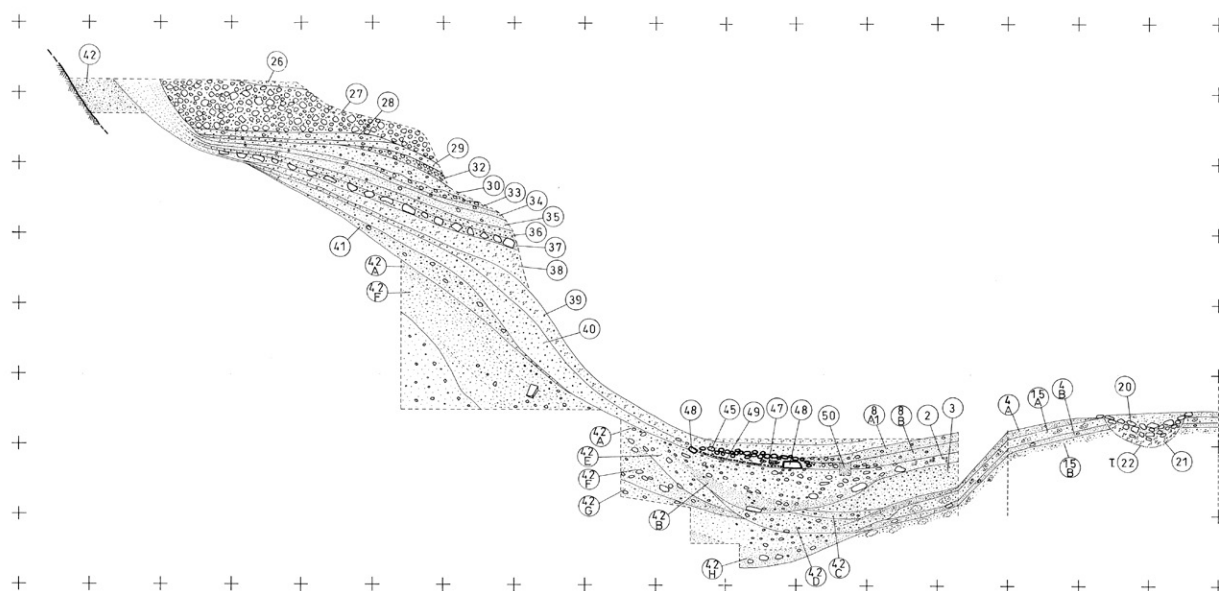


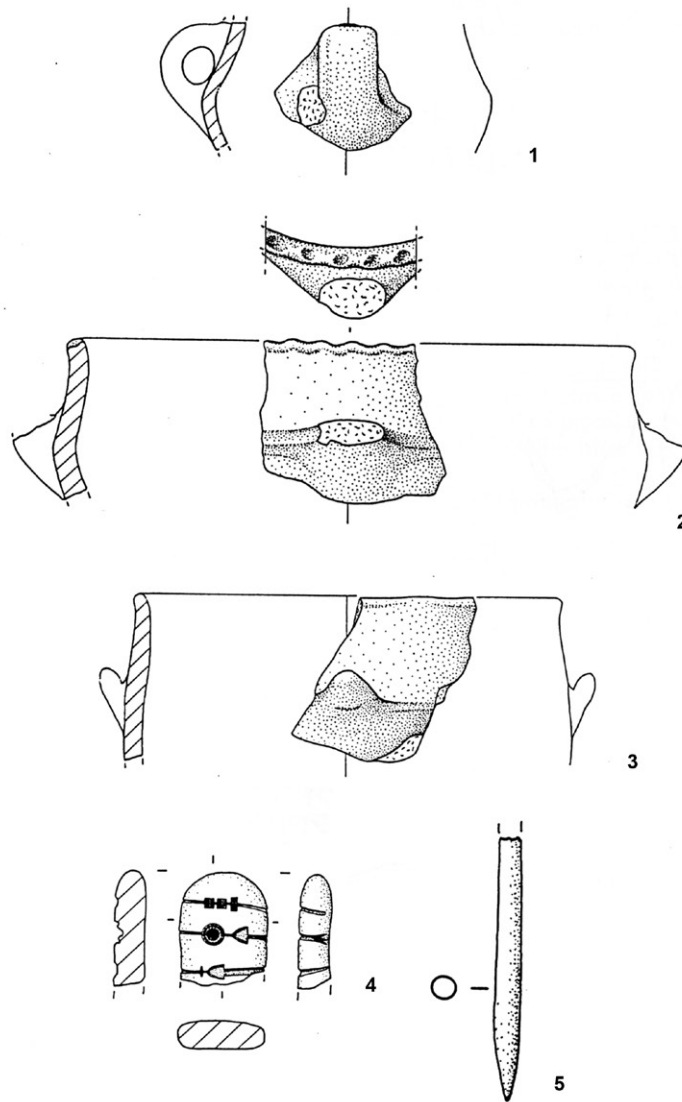
Figura 5. Via Decio Celeri, Lovere (BG). Sezione del deposito archeologico. Gli strati pertinenti all'antica età del Bronzo sono rappresentati dalle UUSS 34, 33 e 30.

Altro sito piuttosto importante è l'insediamento individuato alla base di Monte Covolo, dove, nei vari settori di scavo sono state individuate differenti sequenze stratigrafiche. Già nel 1972 venne individuata da Lawrence H. Barfield una sequenza stratigrafica, anch'essa in gran parte in deposizione secondaria, dovuta al progressivo dilavamento degli strati dai terrazzi superiori dell'abitato. Si tratta di una sequenza che si sovrappone in parte a quella di Lovere, partendo dal Neolitico Tardo fino al Bronzo Antico. Solo i livelli di Bronzo Antico erano in deposizione primaria e presentavano alcuni focolari in situ (Barfield *et al.* 1976, 1979).

Nel Settore 5b degli scavi di R. Poggiani Keller del biennio 1998–1999, dopo una fase dell'età del Rame poco documentata, seguita da un episodio di abbandono, sono documentate tre fasi sovrapposte databili al Bronzo Antico, a cui segue un livello di Bronzo Medio iniziale (Poggiani Keller e Baioni 2004, 2008). I livelli che hanno restituito materiali con elementi di una certa arcaicità presentano una serie di date radiometriche piuttosto antiche che però, come ben evidenziato dagli autori, derivano in gran parte dalle punte carbonizzate di palo rinvenute nelle buche di palo delle tre strutture sovrapposte. Le date calibrate⁹ (vedi fig.) si collocano tra gli ultimi due secoli del III millennio a. C. ai primi due secoli del II. Il modello statistico bayesiano (Figura 7) proposto da E. Valzolgher delle date appartenenti alla 1 fase posiziona questa fase tra il 2300 e il 2000 cal BC (Rapi 2013).

Per quanto riguarda i siti palafitticoli tra le sequenze cronotipologiche più lunghe e ben documentate si possono annoverare il Lavagnone di Desenzano del Garda (BS), di cui ora si propongono 9 fasi insediative (De Marinis 2022) e Fiavè-Carera (TN) con 7 fasi insediative, delle quali solo 5 appartengono all'età del Bronzo (Perini 1984, 1987, 1994). Per quanto riguarda il Bronzo Antico al Lavagnone si riconosce una prima fase insediativa, denominata da Renato Perini Lavagnone 2, datata con la dendrocronologia tra il 2030 e 2012 cal BC, a cui segue una seconda fase denominata Lavagnone 3, datata tra 2004 e 1936 cal BC (De Marinis 2007; Perini 1988) (Figura 8). Nella sequenza di Perini segue il Lavagnone 4, inquadrabile tipologicamente al Bronzo Antico 2 (Perini 1988).

⁹ Le datazioni sono state effettuate dal laboratorio di Roma – La Sapienza (Prof. Gilberto Calderoni) e dai Geochron Laboratories (Massachusetts – USA). Solo per le datazioni fatte in questo ultimo laboratorio venne fornito il δ^{13} . Per la datazione GX25141LS il δ^{13} è di 25,4‰. I campioni sono frammenti di carbone di quercia.



Lovere (Bergamo). Conoide. Reperti dall'US 33 (Da: Poggiani Keller 1999-2000).

Figura 6. Via Decio Celeri, Lovere (BG). Materiali ceramici, in terracotta e in osso provenienti da US 33. Interessante la presenza di una tavoletta enigmatica (rielaborato da Poggiani 2000).

Gli scavi De Marinis hanno individuato un momento che precede la fondazione del Lavagnone 2, rappresentato da un camminamento ligneo, databile con la dendrocronologia tra il 2097 e il 2015 cal BC, recentemente indicato come Lavagnone 1. È stato poi individuata una fase che si colloca tra il Lavagnone 3 e il Lavagnone 4 che precedentemente era indicata con il termine cronologico Bronzo Antico IC e recentemente è stata distinta come Lavagnone 3b. Questa fase non è corredata da datazioni dendrocronologiche (De Marinis 2022).

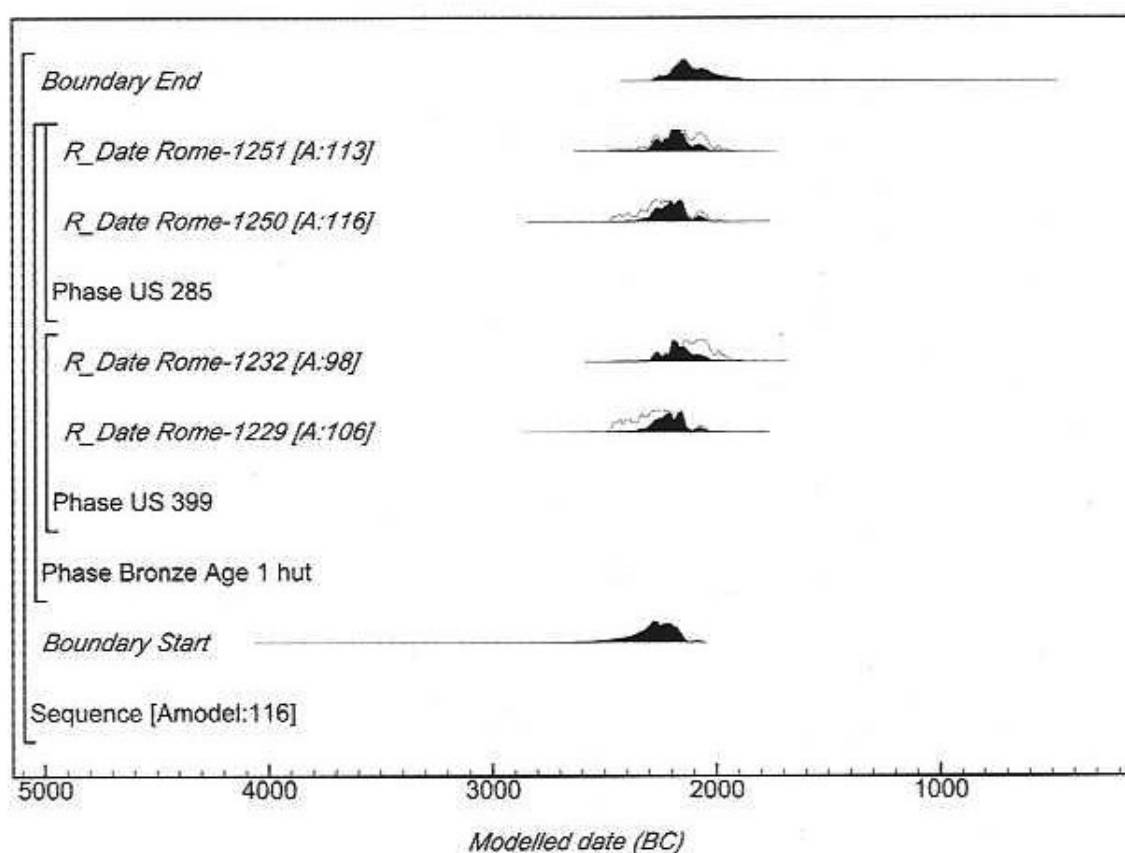


Figura 7. Modello statistico bayesiano proposto da E. Valzolgher sulla base delle date appartenenti alla 1 fase del Bronzo Antico di Monte Covolo – Villanuova sul Clisi (da Rapi 2013).

Per il Bronzo Antico è piuttosto interessante la già citata sequenza del Lucone sito D: qui abbiamo una prima fase (LUD1a), seguita da un incendio (LUD1b) e da una successiva fase (LUD2a-b), che a sua volta presenta un momento di abbandono (LUD2c) (Figura 9). La fondazione del villaggio avviene tra il 2034 e il 2031 e l'abbandono avviene qualche tempo dopo il 1967 cal BC (Baioni *et al.* 2022).

Potrebbe essere presente anche una terza fase individuata nel Settore 2, ma non è ancora corredata da datazioni dendrocronologiche e comunque non corrisponde allo strato C degli scavi del 1986, che invece appartiene alla fase di abbandono LUD2c (Bocchio 1988).

Tra le sequenze di abitato sarebbe particolarmente interessante anche quella di Bande di Cavriana, soprattutto per le sue affinità con il Lucone e il Lavagnone, ma purtroppo i risultati degli scavi sono in gran parte inediti (Piccoli 1982, 1986).

Per un momento più recente dell'antica età del Bronzo grande importanza ha la sequenza di La Quercia di Lazise, una delle poche palafitte sommerse del Garda che presenta una stratigrafia ben conservata. Lo scavo ha infatti evidenziato la presenza di 7 strati, alcuni di interesse antropico (Strati VI, IV, II, I), che mostrano una sequenza che tipologicamente è correlabile al Lavagnone 3 e al LUD2 (strato VI), al Lavagnone 4 (Strati IV, II) e al Bronzo Medio iniziale (Strato I) (Aspes e Morelato 2019). Per questo sito sono disponibili delle datazioni dendrocronologiche basate sulla sequenza GARDA 1-II parte, che individuano una serie di abbattimenti databili agli anni 1938–1935, 1843–1835, che si riferiscono a un segmento cronologico scarsamente corredata di date, ma che solo ipoteticamente possono essere correlate agli strati individuati durante lo scavo (Aspes e Morelato 2019; Fasani 2006).

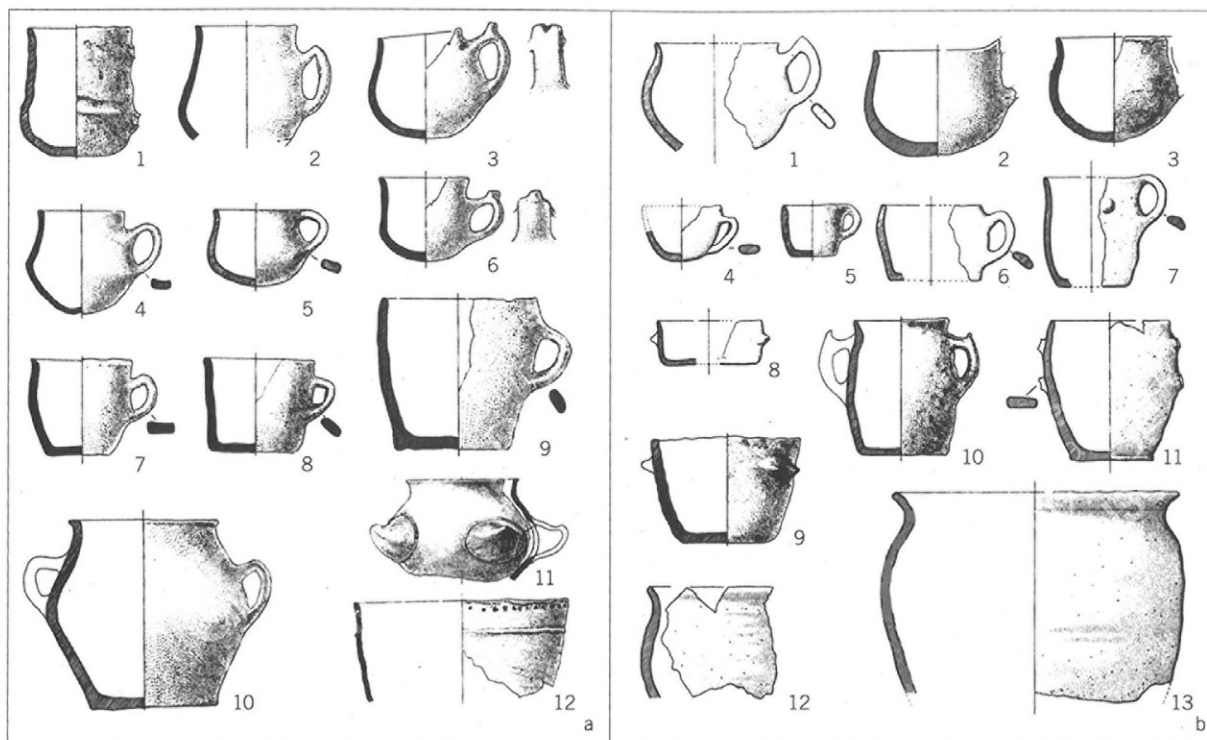


Figura 8. Lavagnone, Desenzano del Garda (BS). Materiali dagli orizzonti del Lavagnone 2 e 3 (da Perini 1988).

Contesti particolarmente significativi per una definizione dei caratteri cronotipologici sono sicuramente Dossetto di Nogara (Salzani *et al.* 2022) e il nuovo contesto di Oppeano 4C (Gonzato *et al.* 2021), entrambi inseriti nella nuova versione della cronologia GARDA 1-I parte (Martinelli 2021). Infine non bisogna dimenticare il sito di Canà di San Pietro in Polesine, di cui si riconoscono principalmente due fasi, una di BA1 e una BA2, e si hanno a disposizione alcune datazioni dendrocronologiche attribuibili a pali non correlabili alla stratigrafia (De Marinis *et al.* 2015; Martinelli *et al.* 1998).

Al momento Fiavè-Carera è l'unico scavo in un contesto palafitticoli di cui sia disponibile una pubblicazione completa dei materiali rinvenuti per tutte le sue fasi (Perini 1987, 1994). Per il Lavagnone, per quanto riguarda il Bronzo Antico, sono disponibili una monografia sul Lavagnone 3a (Rapi 2020) e lavori sul Lavagnone 3b (Rapi 2007) e sui livelli di BA2 del Settore B (Cazzanelli 2007). Per vari contesti sono a disposizione lavori di sintesi con la descrizione delle caratteristiche cronotipologiche delle varie fasi e tavole di sintesi.¹⁰

Le suddivisioni proposte

Per quanto riguarda le proposte di seriazione cronologica del Bronzo Antico, vari autori a partire da Leone Fasani hanno proposto delle suddivisioni (Fasani 1984). Per semplificare il discorso in questa sede prendiamo come riferimento le cronologie proposte da Renato Perini (Perini 2001) e da Raffaele De Marinis (De Marinis 1979, 2002, 2022).

Proprio a partire dagli scavi del Lavagnone di Desenzano e di Fiavè -Carera Renato Perini propose un sistema cronologico che si basava sulla sincronizzazione delle due sequenze cronotipologiche di sito (Lavagnone 1, 2, 3 ecc.; Fiavè 3, 4, 5...) e la correlazione con altri contesti trentini. La sua cronologia distingueva in questo modo il Bronzo antico in 3 fasi:

¹⁰ Per i riferimenti bibliografici si rimanda ai lavori citati per i vari siti presi in esame in questo lavoro.

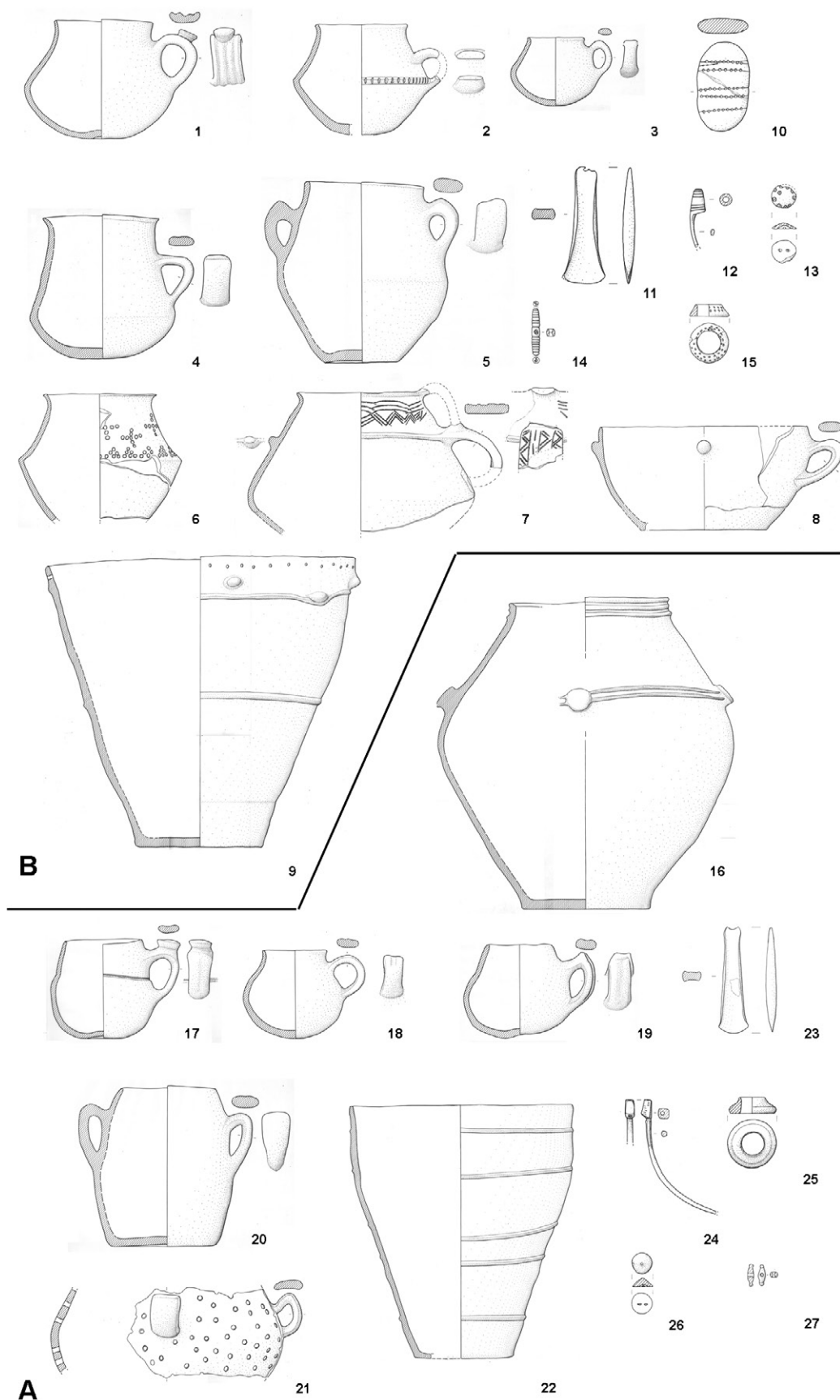


Figura 9. Lucone di Polpenazze del Garda (BS), Lucone D. A) materiali ceramici, in osso corno e metallici pertinenti alla fase LUD1; B) materiali ceramici, in osso corno e metallici pertinenti alla fase LUD2.

Europa centrale		Italia settentrionale			
REINECKE riformulato da WOLFGANG DAVID		DE MARINIS		Dendrocronologia e cross dating	date dendrocronologiche BC
BRONZO ANTICO	Bz A 1	BRONZO ANTICO	BA I A1 (Lav. 1)	2100-2010	Lav. 2077, 2048, 2032 Lucone 2034-2031
			BA I A2 (Lav. 2)	2010-1985	Lav. 2010-2008, 1994, 1992 ; Oppeano 4C 2000-1999 e 1989-1988
	Bz A 2a älter		BA I B (Lav. 3-a)	1985-1900	Lav. 1984, 1957, 1926, 1916 ; Lucone 1967 Dossetto di Nogara 1963-1943 , La Quercia di Lazise str. VI 1938-1935 Leubingen post 1962
	Bz A 2a jünger		BA I C (Lav. 3b, Canàr I)	1900-1750	Canàr: 1869, 1859 La Quercia di Lazise str. VI 1843-1835 Helmsdorf post 1860 Concise-Sous-Colachoz E11: 1801-1773
	Bz A 2b		BA II (Lav. 4, Fiavè 3)	1750-1625	La Quercia str. IV: 1690 Concise-Sous-Colachoz E12: 1646-1619 Meilen Schellen, Schicht A 1660, 1647-1641 Bodman Schachen I B 1644-1640 Préverenges phase 2 1629-1616
	Bz A 2c Bz B älter		BM I (Lav. 5-6, Fiavè 4-5)	1625-1525	La Quercia di Lazise str. II 1588, 1558 Bodman Schachen I C 1618-1591 Wädenswil-Vor der Au 1607-1598
BRONZO MEDIO (cultura delle tombe a tumulo)	Bz B jünger	BRONZO MEDIO	BM II A (Lav. 7, Fiavè 6)	1525-1450	Bad Buchau-Siedlung Forschner: 1511-1481 Aicha an der Donau: 1497
	Bz C 1		BM II B (Lav. 8, Fiavè 6)	1450-1400	Viverone: 1438-1401 ; vasca di Noceto 1444, 1432 St. Moritz: 1411
	Bz C 2		BM III (Lav. 9, Fiavè 6)	1400-1300	Lav. Settore D, Lav. 011: 1423-1333 (74,1%) Danish oak coffins: (1389-1319)
UFK	Bz D 1	BR 1	BR (Fiavè 7)	1300-1225	Elgg-Breiti BS B: post 1290 , BS C: 1230 Danish oak coffins: (1296, 1275)
	Bz D 2	BR 2		1225-1150	Elgg-Breiti BS D1: 1220 BS D2: 1210

Figura 10. Tabella riassuntiva della cronologia elaborata da R.C. De Marinis con le connessioni con la cronologia centroeuropea (da De Marinis 2022).

Bronzo Antico Primo: si tratta del momento formativo della Cultura di Polada, chiamato Polada A locale Serso 1. Questo aspetto è tipico del Trentino centrale e si trova innanzitutto ai Monteserai di Serso presso Pergine e nell'area di Trento (Solteri, Vela Valbusa e Romagnano). Materiali di questa fase provengono anche da Ledro (Perini 2001). In questa fase i caratteri incipienti della Cultura di Polada convivono con tradizioni del tardo eneolitico (Campaniforme) e influenze orientali (Lubiana-Ig).

Bronzo Antico Secondo: periodo tipico della Cultura di Polada (Polada B), che si diffonde in area trentino-gardesana, portando con sé il modello insediativo palafitticolo. Caratteristico di questa fase è l'orizzonte detto Lavagnone 2. Questa fase è ritenuta dall'autore meno presente in area trentina, anche se parte della stratigrafia di Ledro doveva essere pertinente a questo momento.

Bronzo Antico Terzo: momento avanzato dell'antica età del Bronzo, caratteristico del Fiavè 3 e con ogni probabilità presente anche a Ledro, dove sono stati individuati materiali che trovano precisi confronti con appunto il Fiavè 3. Alcuni elementi preludono lo sviluppo del Fiavè 4 che è datato dall'autore al Bronzo Medio Primo (Perini 2001).

Raffaele C. de Marinis, partendo dalla struttura base della cronologia di Perini, ha elaborato e progressivamente modificato una sequenza più dettagliata, basandosi sulle ricerche al Lavagnone. Una prima suddivisione proposta già nel 1979 era tra un Bronzo Antico 1 e un Bronzo Antico 2 con correlazione alla cronologia centroeuropea (De Marinis 1979), in seguito l'Autore distingue tra un BA 1 A, rappresentato dal Lavagnone 2 (Scavi Perini – Settore A) e dal Lucone – strato E (Lucone D, scavo 1986) e un BA 1 B, tipico del Lavagnone 3 (Scavi Perini – Settore A) e del Lucone – strato D. A cui si aggiunge con il prosieguo delle ricerche, un BA 1 C, documentato non in sequenza stratigrafica con gli altri, ma individuato nel nuovo Settore B¹¹ e correlato dal punto di vista tipologico con la fase più antica di Canàr e il sito del Dossetto di Nogara.

Il BA 2 è invece rappresentato dall'orizzonte Lavagnone 4 (Scavi Perini – settore A) e dai contesti parallelizzabili individuati negli altri settori di scavo, e dall'orizzonte Fivè 3 (De Marinis 2002).

Più recentemente l'autore rende ancora più complessa la sua cronologia (Figure 10). Viene introdotto un BA I A1, a cui vengono attribuite le strutture lignee più antiche rinvenute al Lavagnone, indicate come Lavagnone 1 (la cosiddetta timber trackway) e la prima fase del Lucone; segue un BA I A2, corrispondente al Lavagnone 2 e correlabile ad Oppeano 4C. e in parte alla seconda fase del Lucone, che però è parzialmente sincrona al BA I B, rappresentato dal Lavagnone 3 e in parte contemporaneo con Dossetto e alla fase più antica della Quercia di Lazise (Strato VI).

La fase BA I C è rappresentata dagli scarichi presenti nel Settore B del Lavagnone e ritenuto dall'autore contemporaneo a Dossetto e alla fase più antica di Canàr. Segue il BA II con il Lavagnone 4 e il Fivè 3, a cui è attribuito anche lo strato IV della Quercia di Lazise (De Marinis 2022).

Dal raffronto tra le due cronologie emerge soprattutto il fatto, come abbiamo già evidenziato nel 2019 (Baioni *et al.* 2021b), che la cronologia di De Marinis non prevede un momento formativo che invece Perini contemplava. E questo non sembra cambiare neppure con l'introduzione del BA I A1. Inoltre, nell'ultima versione proposta, la mancanza della correzione di 20 anni di cui abbiamo parlato per raffrontare le date del Lavagnone con quelle della sequenza GARDA 1 produce alcune evidenti distorsioni come l'inserimento della prima fase del Lucone nel BA I A1, quando invece vi è una decisa correlazione cronotipologica tra Lucone LUD1 e il Lavagnone 2, posto ora nel BA I A2. Bisogna inoltre ricordare che le date di Dossetto di Nogara e, del resto, i materiali editi sono parallelizzabili con la seconda fase del Lucone (LUD2) e con il Lavagnone 3 e dunque inquadrabili, come giustamente fa De Marinis, nel BA I B e non nel BA I C, come invece viene altrimenti detto.

Due però sono per noi le questioni importanti. Innanzitutto la ceramica poladiana, come si evince dagli importanti lavori editi da Marta Rapi (Rapi 2007, 2020) e dagli studi di prossima pubblicazione sul Lucone (alcune anticipazioni in Baioni *et al.* 2022) e su Oppeano, non presenta tipi esclusivi di una singola fase, se non per forme piuttosto atipiche. La ceramica poladiana presenta un'evoluzione tipologica fluida e continua che permette una distinzione tra fasi solo attraverso il raffronto delle percentuali dei vari tipi. Si consideri che in pieno BA 1 sporadicamente appaiono forme che saranno dominanti nel BA 2. In secondo luogo, si segnalano le evidenti problematiche legate dall'utilizzo di un sito e delle sue cesure per datare tutti gli altri, come se le cesure (incendi, abbandoni) fossero sincroni. Basti pensare che la fase LUD2 inizia probabilmente prima del Lavagnone 3, che invece perdura più a lungo. Nel coro dello sviluppo del Lavagnone 3 invece Bande di Cavriana sembra avere due diverse fasi edilizie, con traslazione delle strutture insediative.

In conclusione, intendiamo proporre una suddivisione in 5 fasi del Bronzo Antico attraverso i dati a nostra disposizione, non tanto per contrapporre un ulteriore schema, quanto per creare una base di lavoro per arrivare a una cronologia condivisa. A questo proposito si considerino le sigle e le denominazioni dei

¹¹ Quindi non si tratta di una sequenza stratigrafica fisica, ma di una successione di fasi con dislocamenti tra i vari settori di scavo del sito con relazioni definite da datazioni dendrocronologiche e osservazioni tipologiche.

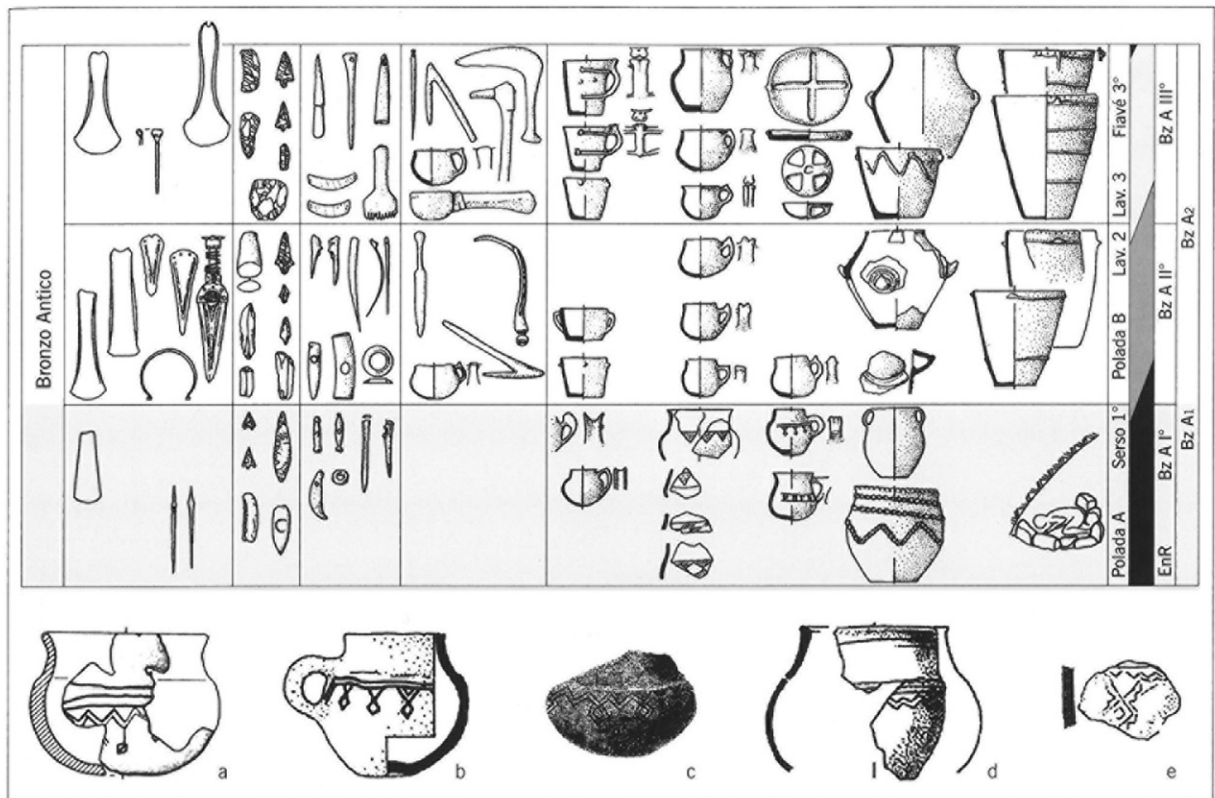


Figura 11. Schema cronologico del Bronzo Antico elaborato da R. Perini con in evidenza le forme vascolari tipiche della fase formativa: a) da Monte Covolo – Villanuova sul Clisi (BS); b) da Ledro (TN); c) da Fimon (VI); d-e) Montesei di Serse (TN) (da Leonardi *et al.* 2015).

periodi una semplice proposta di lavoro che andrà armonizzata con altre proposte per evitare confusioni terminologiche.

BA 1A. Bronzo Antico Fase formativa

Il Bronzo Antico comincia con una fase formativa che sembra al momento non palafitticola, posizionabile tra il 2200 e il 2100 cal BC. Questa fase è datata solamente attraverso datazioni radiocarboniche, spesso con range di calibrazione molto ampi e la sua cronologia presenta una certa sovrapposizione con le date dei contesti campaniformi più tardi. Le date dei principali contesti si posizionano infatti tra il 2300 e il 2000 cal BC (Monte Covolo – Villanuova sul Clisi; Romagnano Loc datazione 2198-2036 cal BC). A questi contesti si può aggiungere il recente rinvenimento del sito in grotta di Grone in Val Cavallina nel Bergamasco. Le analisi radiometriche condotte su un campione di legno¹² hanno fornito una datazione cal 2σ 2580 BC (95.4%) – 2300 BC; un'ulteriore datazione, cal 2σ 2210-2022 BC (92%), è stata ottenuta da una cariosside di orzo.

Monte Covolo, La Vela e Romagnano sono caratterizzati da bassi boccali chiusi che richiamano forme della ceramica accompagnante il Vaso Campaniforme. Questa fase è caratterizzata da sintassi decorative molto particolari già evidenziate da Renato Perini e messe in evidenza per la facies Berico-euganea da Stefano Boaro (Boaro 2005)¹³ (Figure 11).

¹² US 8, quad. I3. Analisi effettuata dal CEDAD dell'Università del Salento nel 2016 (campione 3, LTL16087a). Radiocarbon Age (BP) 3963 $\pm$ 45.

¹³ Per il complesso rapporto con il vaso Campaniforme si rimanda a Leonardi *et al.* 2015.

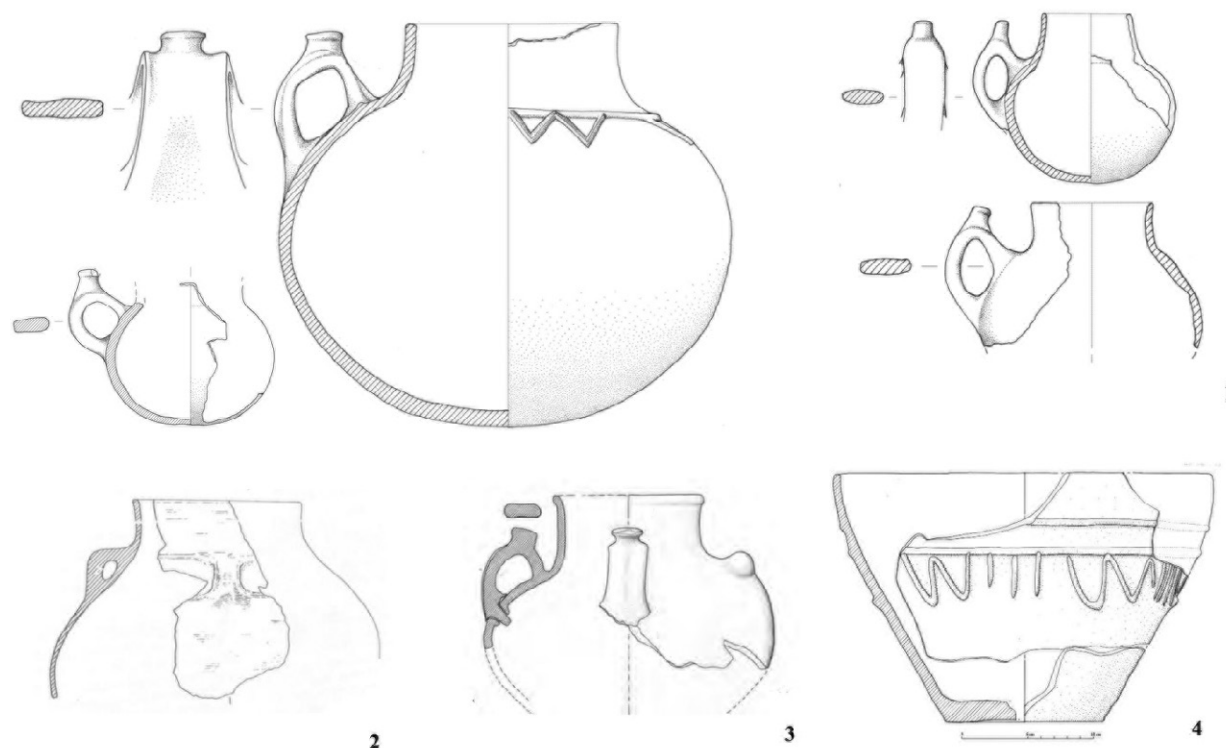


Figura 12. Grotta Altro Pianeta, Grone (BG). Forme ceramiche (1) con confronti per la forma con i livelli campaniformi di Monte Covolo (2), con la fase LUD1 del Lucone di Polpenazze (3-4) (elaborazione C. Mangani).

Grone invece presenta forme molto particolari, con boccali a collo cilindrico e corpo globoso e un grande recipiente con le medesime caratteristiche ma dotato di decorazione a cordoni (motivo che si riconosce ad esempio su un recipiente del Lucone, fase LUD1), tutti provvisti di ansa nastriforme a gomito con terminazione apicale a bottone o a pseudo-bottone cilindrico che richiamano modelli palafitticoli, ma con una caratterizzazione probabilmente locale. Possiamo citare come confronti per l'esemplare di dimensioni maggiori un fiasco¹⁴ rinvenuto a Monte Covolo associato a vasi campaniformi, e per il Bronzo Antico iniziale un esemplare dalla palafitta del Lucone di Polpenazze¹⁵ con ansa con appendice a bottone, ma privo della decorazione a cordoni plastici (Figure 12).

Si evidenzia che, sulla base dell'analisi statistica condotta sui boccali del Lucone, il tipo di imboccatura stretta rientra nel tipo ascrivibile alla fase più antica del sito (Baioni *et al.* 2022).

BA1B. Bronzo Antico Fase Classica, momento iniziale/1

La prima fase propriamente palafitticola sembra sorgere dopo il 2100 (Figure. 13). Tra le datazioni più antiche si possono citare quelle del sito sommerso del Corno di Sotto, in comune di Desenzano del Garda, purtroppo un sito non indagato con uno scavo, ma noto da raccolte subacquee. Le datazioni sono state ottenute da pali senza alburno. Tra i materiali di questo sito sono documentati numerosi manufatti in selce che evidenziano una litotecnica particolarmente arcaica legata più alla tradizione eneolitica che agli sviluppi successivi. Il caso di Corno di Sotto è molto interessante a nostro avviso perché, nel suo

¹⁴ Con ansa tuttavia differente e privo di decorazione plastica (Barfield *et al.* 1995: fig. 59,3).

¹⁵ Baioni *et al.* 2022, fig. 2,20 della fase LuD1b.

[illegible]

Figura 13. Tabella con le principali datazioni dendrocronologiche a disposizione e, in evidenza, le fasi del Lavagnone e del Lucone, corredate di datazioni dendrocronologiche (elaborazione M. Baioni su dati di N. Martinelli).

insieme di aspetti innovativi e arcaici, consente di reinserire il fenomeno poladiano nel locale sviluppo culturale della Lombardia orientale. Questa nostra posizione, espressa in un lavoro del 2015 è stata da alcuni autori (Rapi 2020: 48, nota 48; De Marinis 2022: 415, nota 5) travisata, arrivando ad asserire che secondo noi ‘le prime palafitte sarebbero sorte già verso la fine dell’età del Rame’. In realtà il nostro pensiero è molto differente: la scelta palafitticola della Cultura di Polada, avvenuta proprio in questa fase, ha rafforzato negli studiosi che non si sono occupati dei contesti pluristratificati all’asciutto (Monte Covolo, Lovere – Colle del Lazzaretto ecc.) l’idea di una estraneità della Cultura di Polada con le tradizioni precedenti. Concetto che va perlomeno mitigato.

Anche la costruzione della *trackway* e della palizzata del Lavagnone si può collocare agli inizi di questa fase (circa 2097-2052).

BA1C. Bronzo Antico Fase Classica, momento iniziale/2

Dopo il 2050 si posiziona la prima fase palafitticola classica, rappresentata dal Lavagnone 2 e dal LUD1, di cui sono stati pubblicati varie selezioni di materiali. La datazione di questa fase è ancorata a solo 3 o 4 pali al Lavagnone, mentre 171 sono gli abbattimenti registrati nella fase LUD1.

Il Lavagnone 2 si data dal 2030-2028, mentre l'inizio della fase successiva è datato al 2004.

La fase LUD 1 è datata dalla fase di abbattimento iniziale del 2034-2029, per la fondazione del villaggio fino all'incendio.



Figura 14. Oppeano (VR), Sito 4C. Forma ceramica biconica (4) con decorazione plastica rinvenuta nel livello di incendio della fase 1b che trova confronti al Lucone fase LUD1 (1), al Lavagnone (2) a Bande di Cavriana (3). (1 disegno M. Ravaglia; 2 da Rapi 2007; 3 fornito da A. Piccoli che si ringrazia).

Se l'incendio del Lucone, come abbiamo detto, si colloca dopo il 2017 cal BC e l'incendio del Lavagnone 2 avviene prima del 2004, la cesura tra le due fasi non dovrebbe essere molto distante (Figure 13). Bisogna però sempre ricordare un fattore fondamentale: in una cronologia così fine è molto probabile che le cesure tra gli abitati non corrispondano e che quindi sia a volte difficile applicare a tavolino una cronologia nata per un sito a un altro sito con differente storia.

BA1D. Bronzo Antico Fase Classica, momento centrale

Dopo l'incendio del LUD1 e del Lavagnone 2, poco prima del 2000 a. C. possiamo collocare gli orizzonti LUD2, che finisce poco dopo il 1967, e Lavagnone 3, che sembra continuare oltre il 1936. Si tratta di una fase presente al Lucone, al Lavagnone, a Dossetto, a Oppeano sito 4C. Probabilmente i livelli più antichi di Bande di Cavriana si datano a questo momento.

Ora sembra iniziare l'espansione o il rafforzamento della Cultura di Polada nella pianura, come mostrano le date e i caratteri tipologici di Oppeano. La necropoli di Sorbara di Asola dovrebbe collocarsi qui sia per tipologia di materiali sia per composizione dei metalli, ma le date disponibili sono di scarsa utilità.

La ceramica rinvenuta nel livello di incendio della fase 1b di Oppeano 4C mostra evidenti tracce dell'azione del fuoco. Tra le varie forme si distingue un recipiente che trova chiari confronti al Lucone, al Lavagnone a Bande di Cavriana (Figura 14). Questa fase è stata datata da Nicoletta Martinelli, in un momento immediatamente successivo al 1989-88 $\pm$ 10 cal BC.

BA1E. Bronzo Antico Fase Classica, momento tardo

Dopo questa fase dal Lavagnone e dal Lucone D non provengono altre date dendrocronologiche utili per il Bronzo Antico.

Dal punto di vista tipologico è stato posizionato qui un aspetto chiamato inizialmente BAIC direttamente e solo di recente Lavagnone 3b (De Marinis 2022; Rapi 2020), che non è correlato ad alcuna datazione dendrocronologica. Si trova nel Settore B ed è costituito da scarichi che sono sovrapposti a una fase ritenuta contemporanea a Lavagnone 2 e 3. La collocazione della fase è fornita dalle datazioni dei contesti ritenuti tipologicamente contemporanei come Canà e Dossetto di Nogara. Un palo di Dossetto conservante l'alburno è stato però datato nella fase precedente (1963–1943). Datazioni utili sono ricavabili da Canà e da La Quercia di Lazise, ma non in connessione certa con fasi stratigrafiche (Figure 13).

BA2. Bronzo Antico Fase Tarda

L'ultima fase del Bronzo Antico è quella caratterizzata dalla ceramica tardopoladiana, in cui predominano forme basse aperte come i famosi scodelloni, spesso decorati secondo lo stile Barche di Solferino. Sebbene questa sintassi decorativa non sia sempre presente, il set ceramico è molto caratteristico.

Purtroppo per questa fase non si hanno a disposizione datazioni dendrocronologiche correlate a contesti ceramici. Le uniche date citate in letteratura sono quelle della Quercia di Lazise, (1843–1835) e l'ultimo abbattimento di Barche di Solferino al 1836–1835 cal BC (Martinelli 2022a), ma ancora di recente gli autori dello scavo de La Quercia hanno ribadito l'impossibilità di una correlazione sicura tra stratigrafia e datazioni.

Conclusioni

Come risulta evidente possiamo dire che esistono grandi potenzialità per ricostruire una struttura cronologica condivisa per quanto riguarda il Bronzo Antico tra Lombardia orientale e Veneto Occidentale.

Servirebbe innanzitutto avere a disposizione un numero maggiore di sequenze di sito a disposizione e cercare di corredarle con le datazioni dendrocronologiche: uno delle possibilità più semplici è datare gli elementi lignei orizzontali che per loro natura sono connessi con un determinato strato.

Più complesso a breve termine è il confronto tra cronologia dendrocronologica e radiocarbonica, ricordiamo però che negli ultimi dieci anni le misurazioni sono divenute sempre più precise e sono in corso nuovi progetti di ricerca per l'elaborazione di curva di calibrazione a risoluzione annuale, anche con misure dalle regioni dell'Europa meridionale (Capano *et al.* 2018; Pearson *et al.* 2018).

In cronologie così dettagliate bisogna inoltre considerare che le fasi insediative possono non essere sincrone e dunque prevedere griglie meno rigide.

Si deve ricordare che dal punto di vista cronotipologico la cultura di Polada in molte sue fasi non è caratterizzata da tipi esclusivi, ma da variazioni statistiche dei tipi e dunque in assenza di una pubblicazione esaustiva dei materiali, è difficile alcune volte mettere in correlazione tra loro i complessi.

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Bronze Age dates from the archaeological site of Sa Osa – Cabras

Anna Depalmas,¹ Carmine Lubritto,² Rita T. Melis,³
Mark Pearce⁴ and Alessandro Usai⁵

Abstract

The settlement of Sa Osa (Cabras - OR) is a significant archaeological site because it is atypical of the Sardinian Nuragic Bronze Age in that it has no stone architecture. Because of its excellent preservation, it provides valuable insights into the exploitation of natural resources, agriculture, and early technologies. Evidence suggests that the community engaged in fishing, farming, deer hunting, and specialised production, such as viticulture and pot-making. Excavations uncovered a long-term settlement dating from the Middle, Recent, and Final Bronze Age. Mostly negative features have been preserved. Wells and pits served for water and food storage, some containing fish remains, seeds, cultivated grapes, and even a deer skeleton in their fills. The paper offers a brief overview of the site and discusses the 17 radiocarbon dates available, with Bayesian modelling where multiple dates from single features or contexts allow it. The findings enhance our understanding of Sardinian prehistoric settlements.

Key words: Sa Osa, Sardinia, settlement, radiocarbon, Bayesian modelling, Bronze Age

Résumé

Le site de Sa Osa (Cabras - OR) constitue un gisement archéologique majeur, dont l'originalité au sein du Bronze nuragique sarde réside dans l'absence d'architecture de pierre. Grâce à un état de conservation exceptionnel, il offre des données précieuses sur l'exploitation des ressources naturelles, l'agriculture et les premières technologies. Les indices recueillis suggèrent que cette communauté pratiquait la pêche, l'agriculture, la chasse au cerf ainsi que des productions spécialisées, telles que la viticulture et la poterie. Les fouilles ont révélé une occupation de longue durée s'étendant du Bronze moyen, récent et final. Ce sont principalement des structures en creux qui ont été préservées. Les puits et les fosses servaient au stockage de l'eau et des denrées alimentaires ; certains comblements ont livré des restes de poissons, des semences, des raisins cultivés et même un squelette de cerf. Cet article présente un bref aperçu du site et analyse les 17 datations radiocarbones disponibles, en appliquant une modélisation bayésienne lorsque la multiplicité des dates issues d'une même structure ou d'un même contexte le permet. Ces résultats enrichissent notre compréhension de l'habitat préhistorique en Sardaigne.

Mots-clés: Sa Osa, Sardaigne, habitat, radiocarbones, modélisation bayésienne, âge du Bronze

Introduction

The area around the gulf of Oristano was intensely settled, especially during the last four thousand years (Depalmas and Melis 2010). Most of the earliest evidence is in the nearby Sinis Peninsula with Neolithic settlements documented around the Cabras Lagoon. The density of settlements increased during the 'Nuragic' period (1800–510 BC). Peaks of activity are reported in the Middle Bronze Age (1700–1300 BC), and from the Final Bronze Age to the Early Iron Age (1150–730 BC).

The Nuragic period ended with the establishment of Punic settlements (c. 500 BC) along the coast and in the Campidano plain. The Roman occupation started at around 200 BC, but the area experienced a slow 'Romanization' over the course of several centuries. The prehistoric and historic archaeological evidence indicates a comparatively less dense human presence on the alluvial plain of the river Tirso.

The archaeological site of Sa Osa, located in the coastal plain of Oristano, is partly sited on an alluvial terrace of the river Tirso, about 5–6 metres above sea level, and partly on the alluvial plain of the river,

¹ Dipartimento di Scienze Umanistiche e Sociali, Università di Sassari; depalmas@uniss.it

² Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche, Università degli Studi della Campania Luigi Vanvitelli; carmine.lubritto@unicampania.it

³ Dipartimento di Scienze Chimiche e Geologiche, Università di Cagliari; rtmelis@unica.it

⁴ Department of Classics and Archaeology, University of Nottingham; mark.pearce@nottingham.ac.uk

⁵ Soprintendenza Archeologia, Belle Arti e Paesaggio per la città metropolitana di Cagliari e le province di Oristano e Sud Sardegna; alessandro.usai@cultura.gov.it

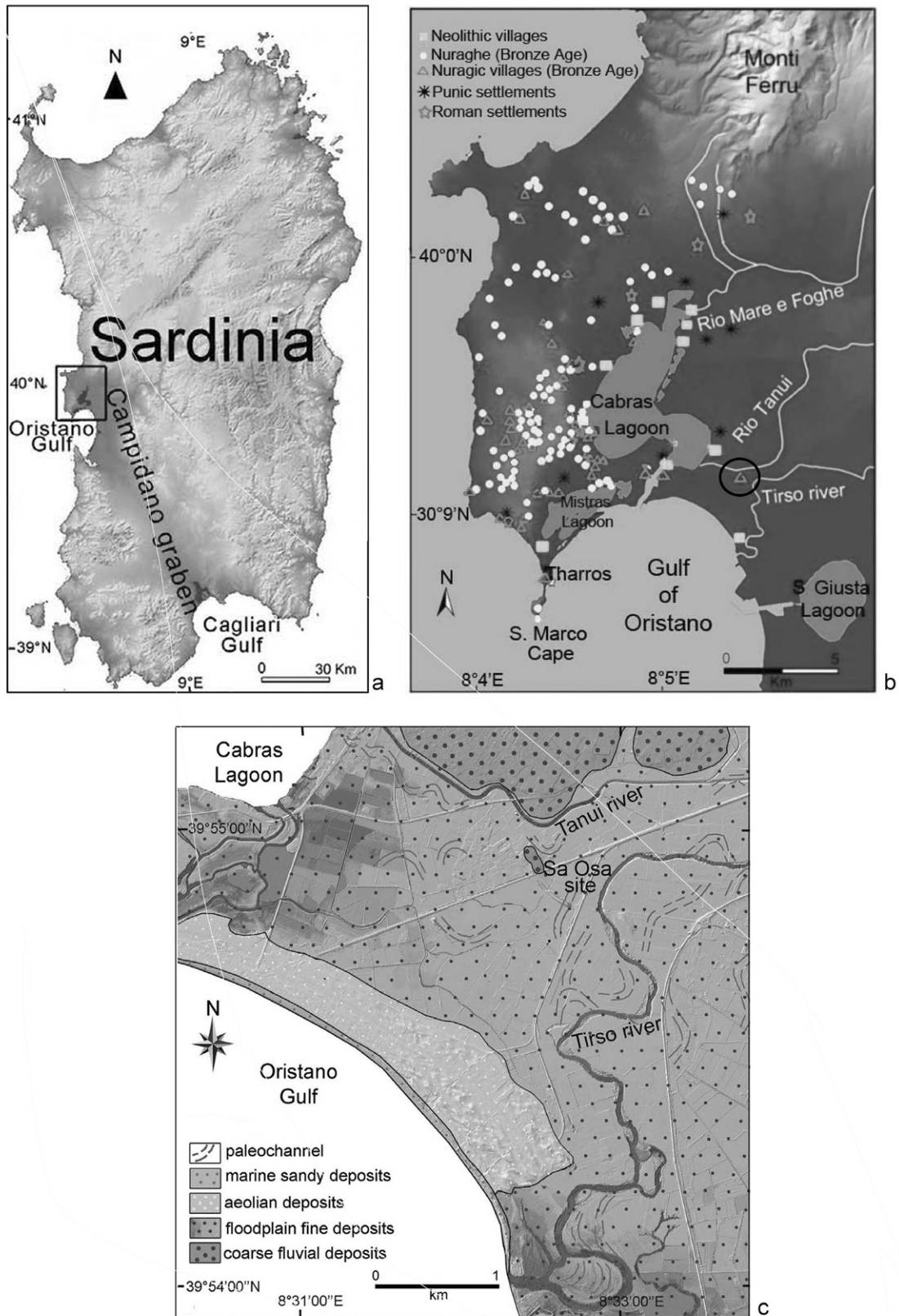


Figure 1. Location of the study area in central-western coastal Sardinia (a); distribution of archaeological sites in the Sinis and Tirso coastal plain area (b); schematic geomorphological map in the Tirso coastal plain (c). After Melis *et al.* 2017, modified.

which dates from the Holocene (Figure 1; Di Rita and Melis 2013). Sa Osa is a unique Nuragic settlement, in as much as it is a rare example of a village with minimal surviving wall structures and without a typical stone-built nuraghe, a key element of Sardinian Bronze Age settlements.

Geology and geomorphology

The Sa Osa site is located in the river Tirso coastal plain, in the northern part of the Gulf of Oristano (central-western Sardinia). The gulf represents the western boundary of the Campidano graben, a Pliocene-Quaternary structural depression which is oriented NW-SE (De Falco *et al.* 2015) and filled by transitional, marine and continental deposits. The area is bounded on the seaward side by a sandy shoreline and to the east by the Tirso alluvial plain. Several lagoons, brackish and freshwater marshes and backshore dunes characterise this coastal environment.

Both the geological and geomorphological setting of the area are related to the tectonic evolution of the Plio-Pleistocene Campidano Graben (Casula *et al.* 2001), and to the interaction between sea level changes and river dynamics (the river Tirso and the Rio Tanui) during the Holocene (Figure 1).

The river Tirso plain is characterised by Holocene silts, muds, floodplain deposits and fluvial channel sandy sediments. Abandoned meanders, wetlands, and river terraces document changes in the fluvial dynamic that, together with the evolution of the late Quaternary shoreline, promoted the formation of several lagoons and ponds. Dune systems, lagoon and marshy deposits constitute the backshore area shaped by the continuous modifications of the final portion of the river Tirso. Parts of the inland plain were highly modified during the last century as a result of drainage works and the construction of agricultural canals.

The stratigraphic analysis of deep cores (Melis *et al.* 2017) showed that during the Neolithic period the study area comprised a coastal plain characterised by the prevalence of wetland and marshy areas. Subsequently, from the Copper Age to the Punic-Roman period, the entire area experienced a progressive increase in the supply of fluvial sediment. This process was influenced by both climatic variations and human impact, as evidenced by the high density of prehistoric and historic settlements throughout the area. It is likely that continuous deforestation of areas upstream favoured soil erosion, leading to an increase in the load of the river Tirso and progressive sedimentation in the coastal plain in front of the settlement.

The increase in human impact is confirmed by the palynological study conducted on sediments in the nearby Mistras lagoon (Di Rita and Melis 2013). The pollen diagram highlighted an increase in indicators of anthropogenic origin and microcharcoal in the time interval between 5300 and 1600 cal BP.

The archaeological context

The site of Sa Osa, previously referred to in the archaeological literature as S'Arrieddu or Serra Siddu, was known for surface finds of a few sherds of a Middle Bronze Age pottery with an internal rim and wheel-thrown fine-ware from the Final Bronze-Early Iron Age. As a result of several changes to the route of the planned new Oristano – Cabras road, to take into account the existing bridge over the river Tirso and the development of the industrial area of Cabras, the site of Sa Osa was fully impacted by the construction of a large roundabout. Rescue excavations, jointly directed by the Archaeological Superintendency of Cagliari and the University of Sassari, began in August 2008 and concluded in December 2009. Further excavation work carried out between 2015 and 2016 led to the identification and investigation of two additional features.

The settlement, dated to the Middle, Recent and Final Bronze Age, is one of the few Sardinian archaeological sites which allows us to reconstruct a complete picture of later prehistoric developments in the exploitation of natural resources, agricultural technologies, husbandry and hunting.

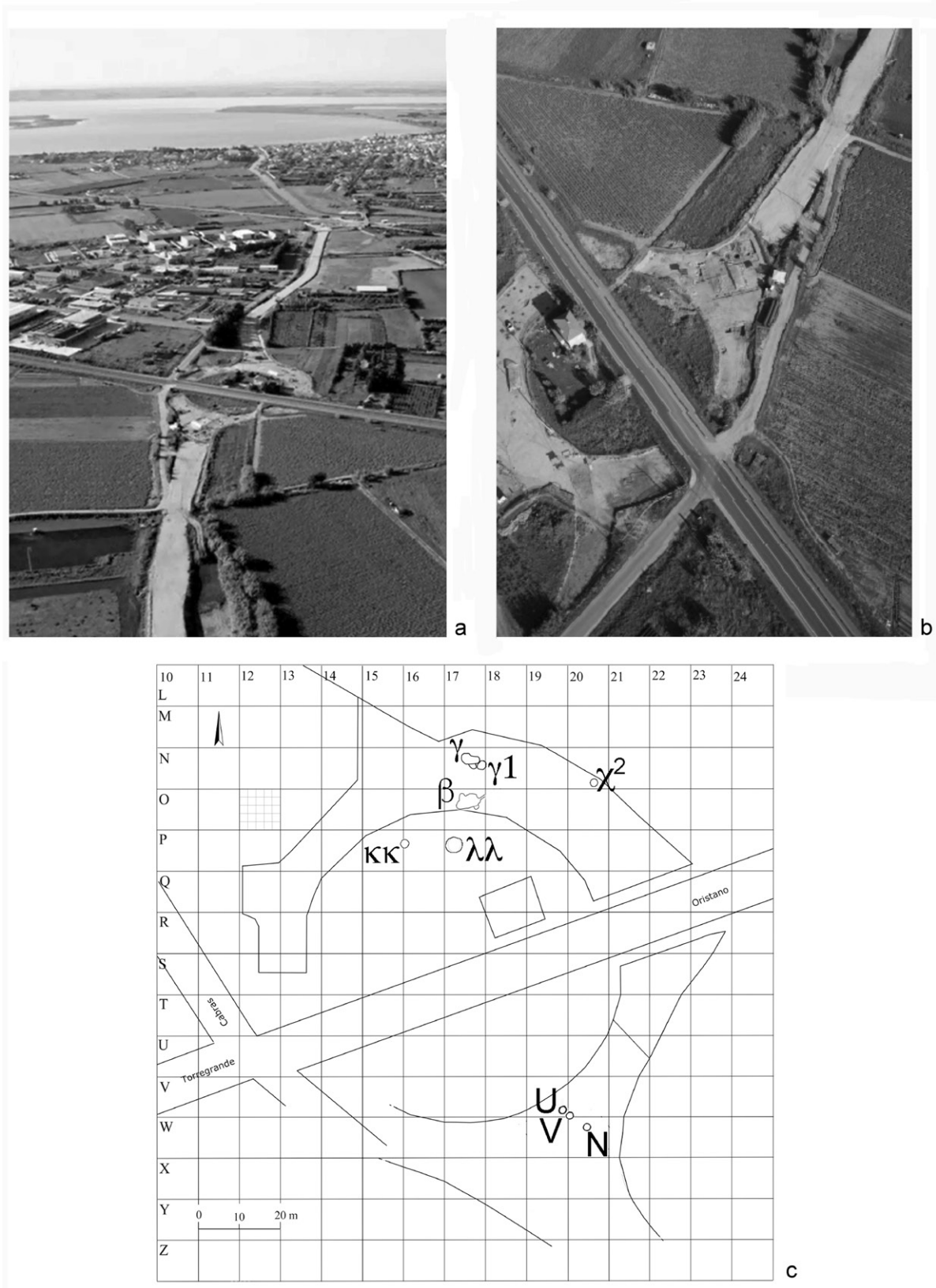


Figure 2. Aerial views of the Sa Osa site during the construction of the Oristano – Cabras road (a–b); location of dated structures (c). Reworking by A. Depalmas (c).

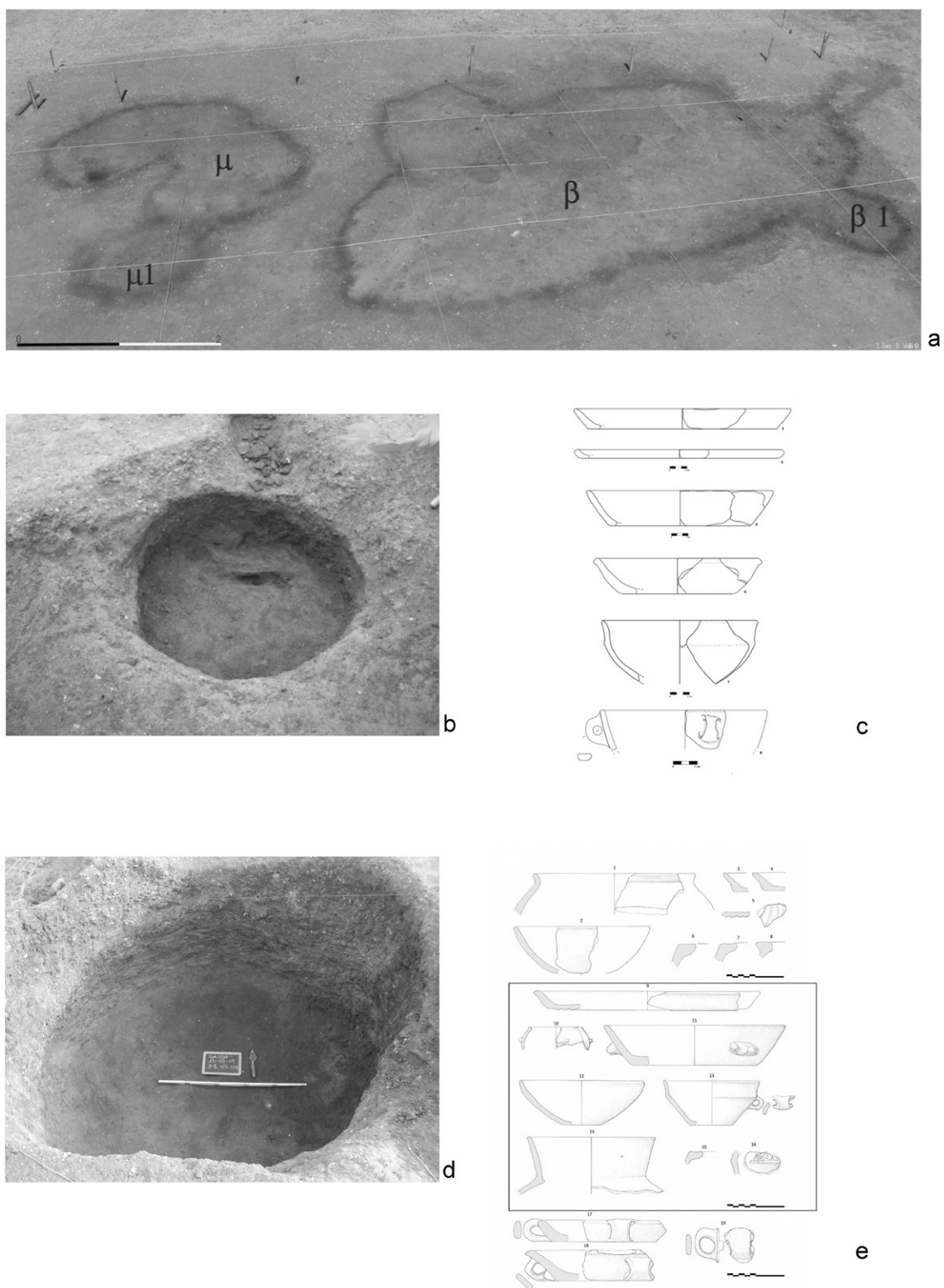


Figure 3. Features in the Northern Sector. Feature β before excavation (a); feature x_2 at the beginning of excavation (b) and pottery finds (c). Feature γ_1 (d) and a pottery selection with finds from US 526 highlighted inside the box. After Dedola *et al.* 2020 (b-c); after Casu 2017 (e).

The settlement structures were made of perishable materials, and so all that now remains are elliptical or circular negative features, such as pits, silos, shafts and wells whose fill is rich in ceramics, stone tools and floral and faunal remains. Further finds include hearths, terracotta slabs, and other objects recovered from the fills of the features.

In the village of Sa Osa, there are also interesting indications that the local community exploited local resources (e.g., river and sea fishing, pig and cattle husbandry, and deer hunting) and also engaged in specialised production (e.g., viticulture, pottery, and bone implement manufacture) (Depalmas *et al.* 2021).

The Torre Grande – Madonna del Rimedio provincial road divides the site into two main sectors: the northern and southern sectors (Figure 2). The Northern Sector lies on an alluvial terrace and extends over approximately 3000 m², corresponding to the highest point in the area (6 meters above sea level) and along the gentle slope that descends toward the river Tirso. In this sector, a range of pits, shafts, cavities and wells were discovered; the features are labelled with Greek alphabet letters. Excavations revealed that the pits often cut each other, were irregularly shaped, and came in different sizes. These pits contained many ceramic artefacts and fragments of fired clay, some bearing impressions of branches and reeds, which likely related to the walls and roofs of buildings (Usai *et al.* 2012) (Figure 3). The area with the highest concentration of features is located at the top of the rise and in the area that gently slopes down towards the northwest. At least ten negative features (pits) of very different sizes can be clearly identified, ranging from a maximum of approximately 17 m² to 5 m² in area (Usai *et al.* 2012).

In particular, in the Northern Sector, shaft β1 intersects the southeastern edge of feature β, shaft μ1 cuts the southern edge of the small pit μ, and silo γ1 is almost tangent to feature γ. In this sector, the shafts – cut into the alluvial terrace – have circular openings approximately 90 cm in diameter without a stone rim (which is attested around some shafts in the Southern Sector). Access into and out of the shafts was made possible by footholds carved into the sides and vertically aligned.

The investigated features yielded relatively homogeneous contexts from the Middle Bronze Age, while the shafts appear to date to later phases, from the Recent Bronze Age and particularly to the Final Bronze Age (Figures 7–8).

The larger features, which have a range of less irregular outlines – elliptical (γ), kidney-shaped (α and μ), and elongated with lobes (β) –, have been interpreted as the floors of rooms intended for different domestic and productive purposes, and not necessarily residential. Feature β, however, is the largest, deep, and elliptical with lobes, and might have served a residential function. The discovery in some of them (especially in feature α) of fragments of daub with clear traces of branches and reeds suggests a superstructure made of wood, brush, and mud. The interpretation of pit γ1 is more difficult; it appears to be annexed to feature γ, it has a circular plan, is very deep, and is rich in ceramic, lithic and faunal material.

The Southern Sector was largely covered by archaeological deposits; features in this sector were labelled with Roman alphabet letters. Here, small to medium-sized pits, the remains of structures, cylindrical shafts, and wells were uncovered. Originally created for various uses like housing, water supply, or quarrying, these features may have subsequently been used for landfill or food storage (Figures 5–6).

Shafts N, U, V, and K were particularly significant in this sector. Shaft N, excavated to a depth of 5 meters, contained a large amount of well-preserved pottery such as pans, bowls, jars and crucibles with copper slag. Organic remains of grapes, figs, hazelnuts and even marine fish bones were also recovered, preserved by the waterlogged conditions (Usai *et al.* 2012). After the excavation, archaeobotanical studies identified 877 fragments of waterlogged wood and charcoal from 20 different species, along with grape seeds (*Vitis vinifera*), melon seeds (*Cucumis melo*) and mulberry remains – the earliest known examples of these fruits in Western Europe (Sabato *et al.* 2015).

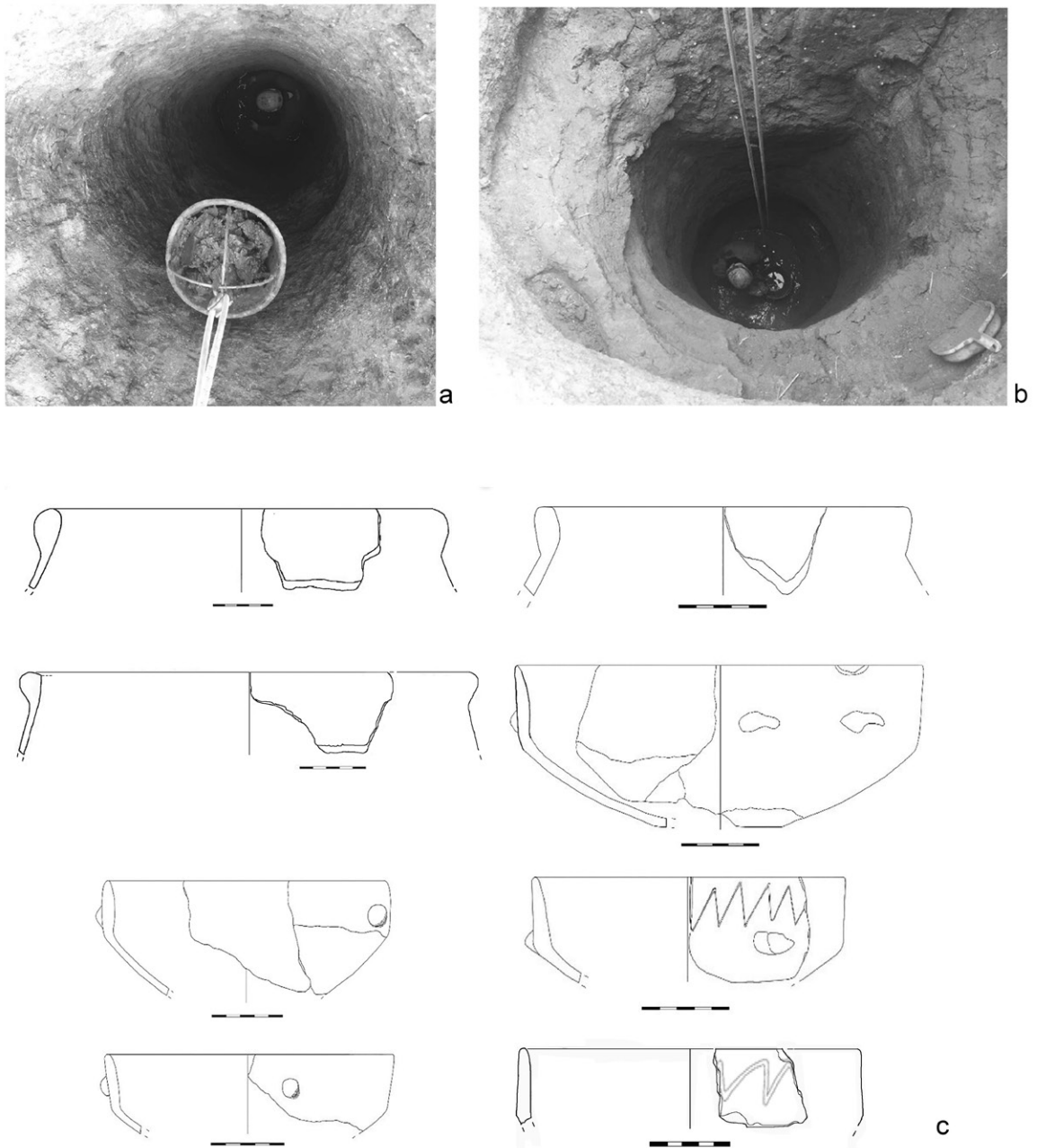


Figure 4. Features in the Northern Sector. Shaft κκ under excavation (a). Shaft λλ under excavation and Final Bronze Age pottery finds (c). After Ortu 2022 (c).

Shafts U and V were excavated to a depth of 4 meters, revealing Middle and Recent Bronze Age pottery and numerous organic remains, including barley, wheat, lentils, peas, and broad beans (Usai *et al.* 2012) (Figure 6). The radiocarbon dates for grape pips from these shafts, which were interpreted as domesticated white grapes, are reported in Figure 7 and discussed below.

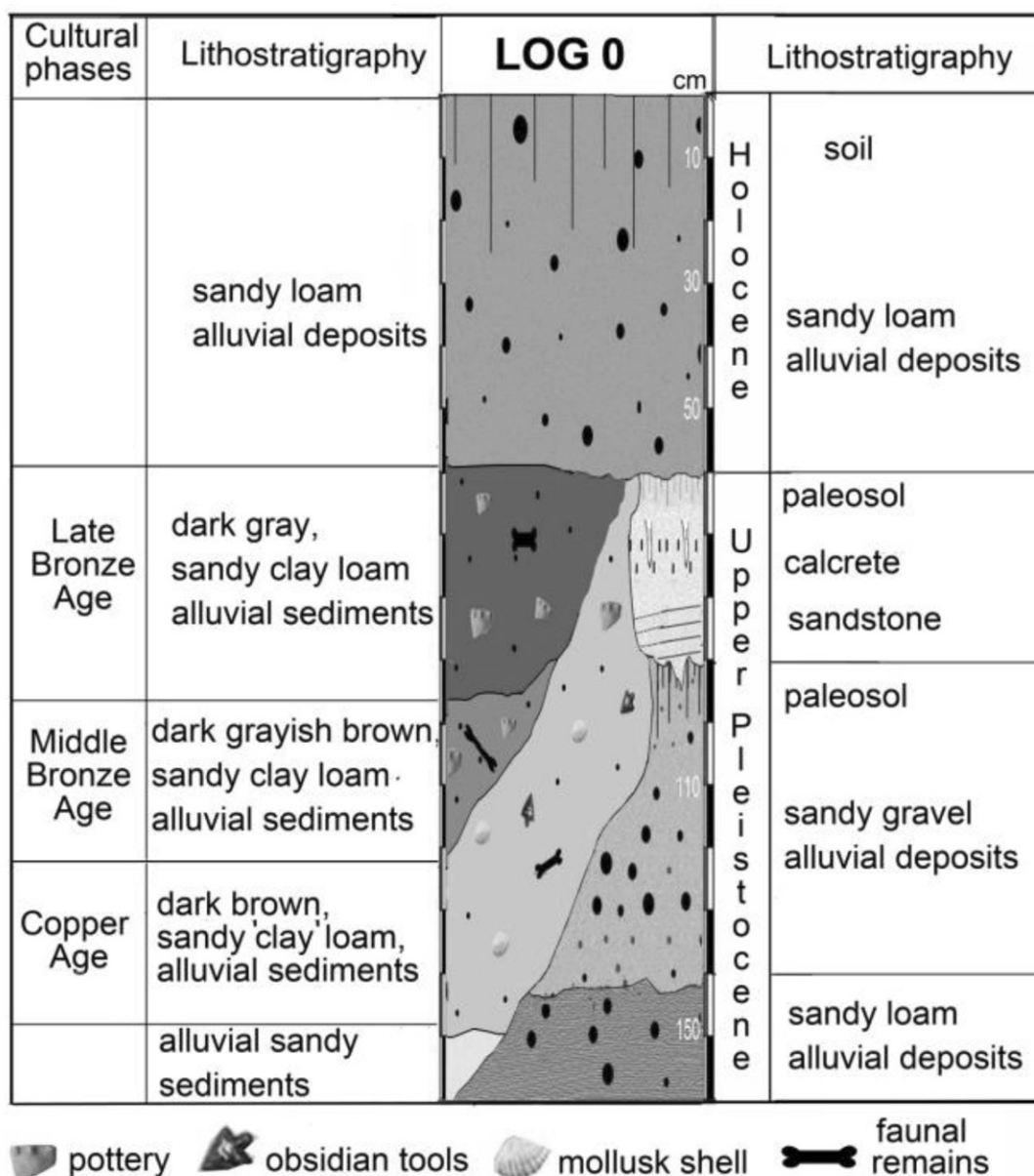


Figure 5. Stratigraphic scheme for the Southern Sector by R.T. Melis.

Shaft K was shallow and covered by a sandstone slab with a circular hole. It was probably not used for water supply but is notable for containing the skeleton of a red deer (*Cervus elaphus*), which had been skinned but not butchered, likely sealed by flood sediments. The pottery suggests a Final Bronze Age or Early Iron Age context (Usai *et al.* 2011).

The last shafts to be excavated in the Northern Sector, labelled κκ (Figure 4, a) and λλ (Figure 4, b–c), were again found to contain deposits rich in organic materials such as seeds, wood, and fauna. As in the other shafts, these remains were well-preserved due to the high water-table which waterlogs the deeper parts of the features. The archaeological site of Sa Osa and the surrounding area are thus of great importance because the sediments potentially contain important information concerning the prehistoric environment.

The different phases of occupation are documented by anthropic and natural layers, and also by cylindrical shafts and features of varying shapes and sizes. Most of the shafts can be interpreted as water

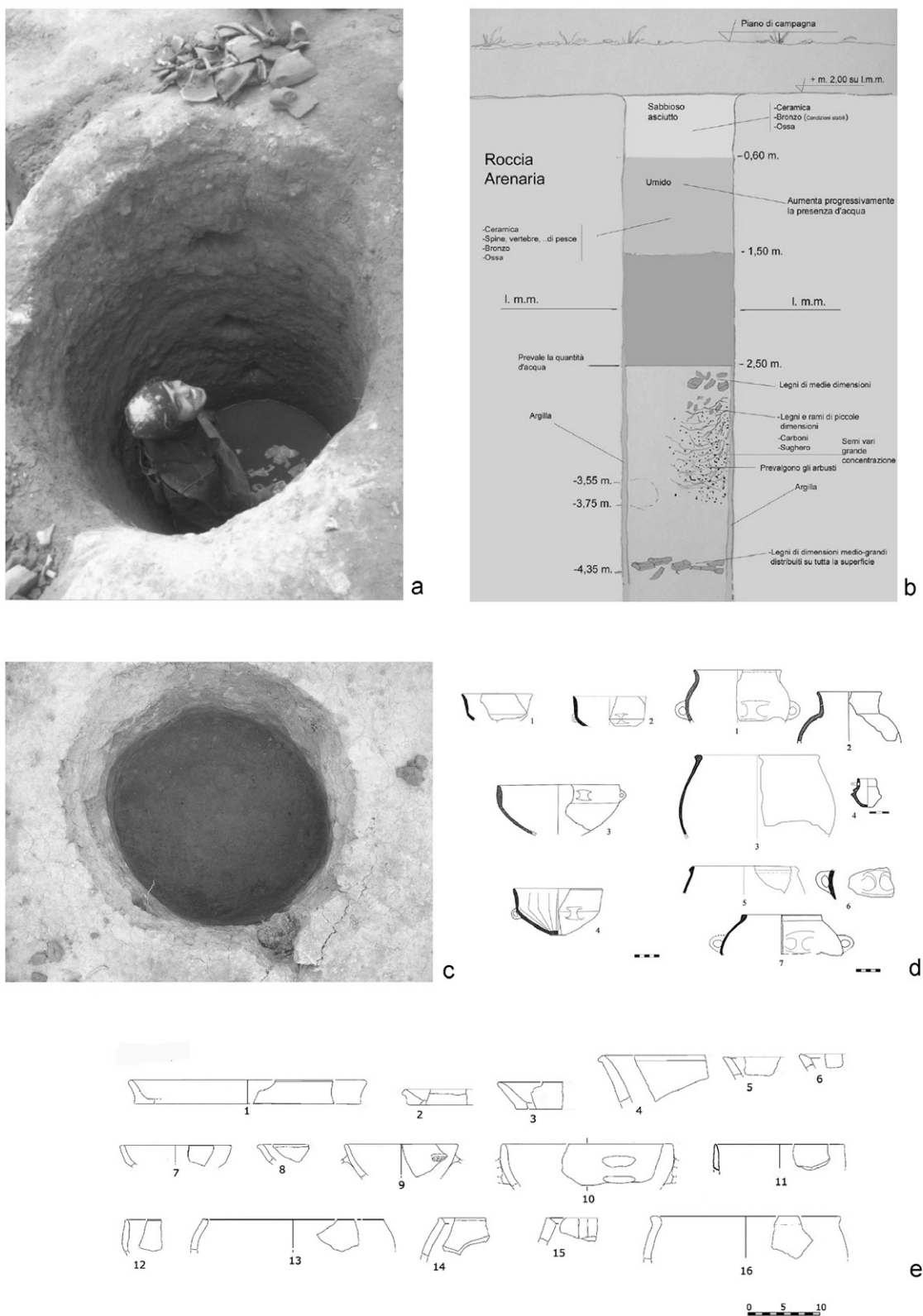


Figure 6. Features in the Southern Sector. Shaft N under excavation (a); section of the shaft (b) and pottery finds (d). Shaft U under excavation (c) and pottery finds from US 433 (e). After Sanna 2011 (b); Serreli 2011 (d); Sebis 2020 (e).

Feature	Context	Lab. No.	Measurement BP	$\delta^{13}\text{C}$	Calibrated BC 95.4%	Calibrated BC 68.3%	Material	Reference
$\gamma 1$	US 526	Fi-2953	3240 $\pm$ 70	-19.9 $\pm$ 0.2	1731–1321	1609–1433	bone	
V		DSH-2643	3223 $\pm$ 32		1537–1422	1510–1447	wood, Olea europea	Usai <i>et al.</i> 2016: 114
β	US 537	RICH-21849.1.1	3179 $\pm$ 33	-19.85	1509–1398	1497–1424	long bone, animal	
$\lambda\lambda$	-3.82 m	DSH-6993_S	3097 $\pm$ 30	-33 $\pm$ 2	1431–1275	1416–1304	charcoal (core sample)	
X 2		Fi-3009	3080 $\pm$ 50	-17.4 $\pm$ 0.2	1491–1211	1411–1285	tooth	
V	US 434	Beta-369366	3020 $\pm$ 30	-22.0	1391–1130	1373–1219	seed, Vitis	Ucchesu <i>et al.</i> 2015: tab.1
$\lambda\lambda$	-3.10m	DSH-6994_S	3006 $\pm$ 20	-30 $\pm$ 1	1378–1130	1281–1214	charcoal (core sample)	
U	US 433	Beta-369365	3000 $\pm$ 30	-21.1	1381–1124	1286–1132	seed, Vitis	Ucchesu <i>et al.</i> 2015: tab.1
N	US 171	OxA-25106	2981 $\pm$ 27	-19.72	1371–1116	1261–1129	seed, Vitis	Ucchesu <i>et al.</i> 2015: tab.1
N	US 171	Beta-345402	2980 $\pm$ 30	-26.5	1375–1059	1261–1128	seed, Cucumis	Sabato <i>et al.</i> 2019: 791
N	US 171	OxA-25107	2968 $\pm$ 27	-21.54	1277–1056	1224–1126	seed, Vitis	Ucchesu <i>et al.</i> 2015: tab.1
$\kappa\kappa$	P71	Beta-667692	2990 $\pm$ 30	-21.3	1376–1121	1270–1129	seed, Vitis	Ucchesu <i>et al.</i> 2025: 3, S2
$\kappa\kappa$	-5m	DSH-6992_S	2977 $\pm$ 19	-26 $\pm$ 1	1265–1123	1258–1130	charcoal (core sample)	
V	US 434	DSH-2641	2714 $\pm$ 40		968–802	898–819	wood, Ficus carica	Usai <i>et al.</i> 2016: 114
V	US 434	DSH-2637	2576 $\pm$ 44		819–545	808–593	wood, Ficus carica	Usai <i>et al.</i> 2016: 114
Y	US 522	Fi-3010	2500 $\pm$ 130	-20.2	917–233	787–480	bone	
$\lambda\lambda$	US 1018	Fi-3013	2300 $\pm$ 170	-19.6	803 BC–25 AD	747–162	bone	

Figure 7. Radiocarbon dates from Sa Osa, calibrated using OxCal v4.4 and the IntCal20 curve (Reimer *et al.* 2020).

wells that were probably later reused for food storage. Integrated processing of all this data is crucial if we are to make a general interpretation of the environmental and anthropic phenomena documented by archaeology and geo-archaeology. It will also be a useful starting point for the comparative investigation of similar contexts in other Mediterranean island environments.

Dated contexts

Feature β – This is a significantly larger feature compared to others in the Northern Sector, very deep, with an elliptical plan and lateral lobes to the southeast and northwest, and partition walls preserved at the bottom. A residential function has been suggested for this structure. Although the study of the material has not yet been completed, the finds mostly date to the Middle Bronze Age. The area of the feature is calculated to be 17.60 m² (maximum dimensions: 6.10 × 3 m) (Usai *et al.* 2012: 774) (Figures 2, c; 3, a).

Feature γ – A small, slightly sunken elliptical feature containing a seemingly disordered cluster of shallow post holes with small diameters (approximately 10 cm). Pending further analysis of the material, it is suggested that this may document a temporary wooden structure linked to the cyclical handling and processing of foodstuffs stored in silo γ 1. The materials date to the Middle Bronze Age. Area: 9.64 m² (maximum dimensions: 4.55 × 2.43 m) (Usai *et al.* 2012: 774) (Figure 2, c).

Feature γ 1 – This is located adjacent to γ , but the material contained in feature γ 1 is not useful for interpreting its original function, as it seems to be related to its secondary use as a refuse pit. However, its cylindrical shape, regular walls and floor, and fragments of plaster that possibly document insulating wall-lining, support its interpretation as a food storage silo. Two distinct fill phases were identified, separated by a long-lasting intermediate layer (archaeological context US 526): the first phase (archaeological contexts US 528 and US 527) dates to the late Middle Bronze Age 1, and the second (archaeological contexts US 525, US 522 and US 514) to Middle Bronze Age 2. Area: 3.60 m² (diameter 2.26/2.40 × 1.60 m deep) (Casu 2017) (Figures 2, c; 3, d–e).

Feature N – This feature is cut into sandstone with a slightly narrowing cylindrical shaft and five footholds carved into the SW wall. Excavation exceeded 4 m in depth but did not reach the bottom. It is likely a genuine well for water supply. Finds include nearly intact pots, a large amount of large ceramic fragments, and organic remains (mammal and fish bones, plant matter, grape and fig seeds, cork, and worked wood). The ceramic assemblage (pots, pans, bowls, cups) dates to the very late Recent Bronze Age or possibly the early Final Bronze Age. Notable finds include a handled crucible and various lamps on tall feet. Dimensions: 1 m in diameter and over 4.10 m deep (Serreli 2010) (Figure 2, c; 6, a–b, d).

Feature U – A regular cylindrical shaft cut into sandstone, without a stone rim. The pottery found (US 291, US 311, US 433) includes baking pans, cooking pots, bowls, cups, and jars. Many pans show basket imprints or incised lattice decoration. Some of the jars feature vertical ridges starting from the rim and loop handles near their widest point. We may suggest a date in the late Middle Bronze Age on typological grounds, though some surface finds belong to the Early Iron Age. The botanical remains include barley, durum wheat, lentils, peas, broad beans, and fruits like blackberries, elderberries, figs, and grapes. Dimensions: 1 m in diameter and over 4 m deep (Uccesu *et al.* 2015a, 2025; Usai *et al.* 2012: 777; Usai *et al.* 2016; Sebis 2020) (Figures 2, c; 6, c, e).

Feature V – Like feature U, it has a regular cylindrical shaft cut into sandstone with no stone rim. The ceramic materials found suggest it can be dated within the Middle Bronze Age. Dimensions: 1.2 m in diameter and over 4 m deep (Serreli 2017; Usai *et al.* 2012: 777) (Figures 2, c).

Feature χ^2 – A cylindrical well without a rim, with six footholds carved into the east and west sides spaced 12–29 cm apart. Most of the artefacts recovered date to the Middle Bronze Age. Dimensions: 0.94 m in diameter and 3.6 m deep (Dedola *et al.* 2020; Usai *et al.* 2012: 774) (Figures 2, c; 3, b–c).

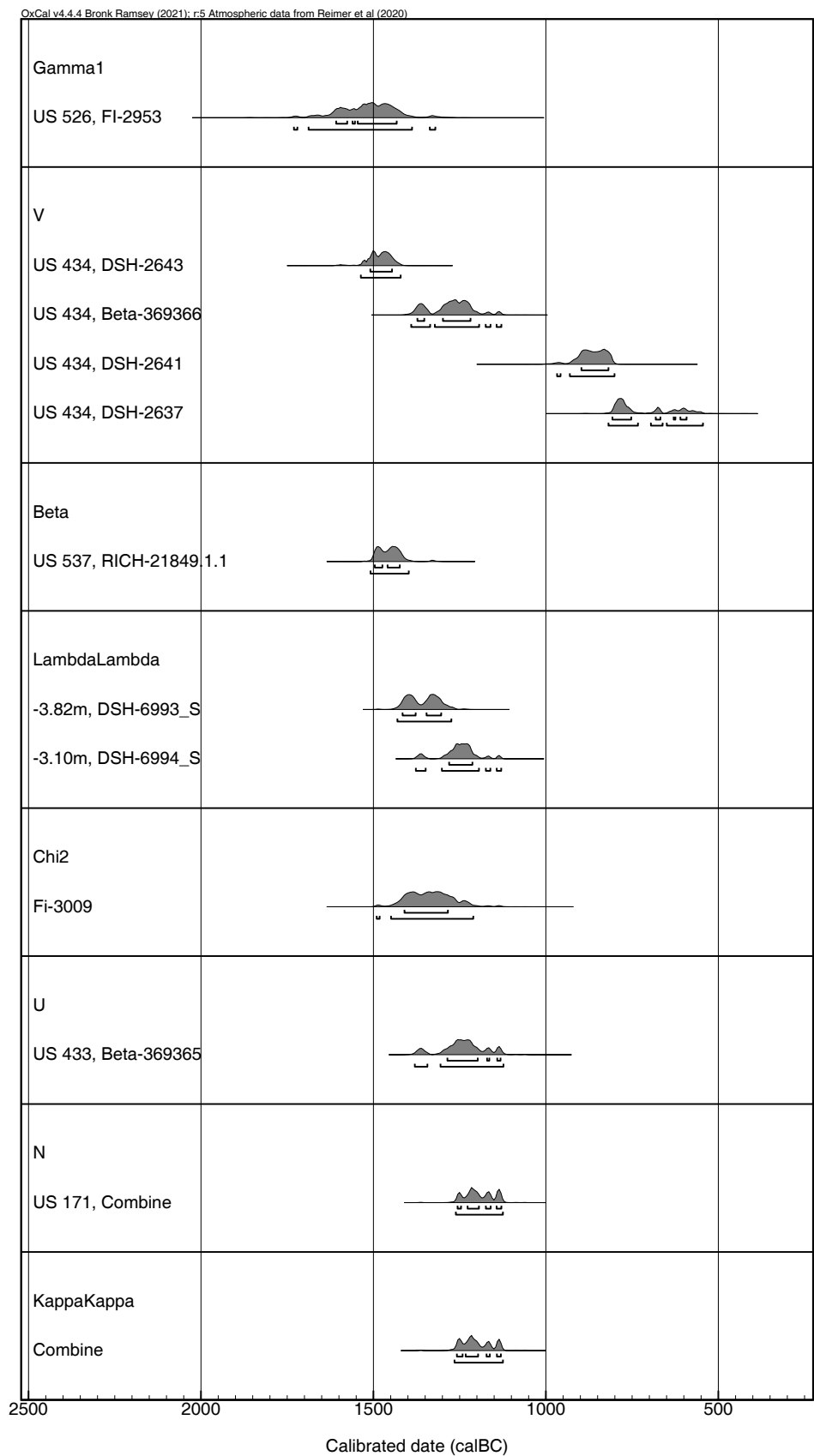


Figure 8. Calibration plot of the radiocarbon dates from Sa Osa, organised by feature; calibrated using OxCal v4.4 and the IntCal20 calibration curve (Reimer *et al.* 2020).

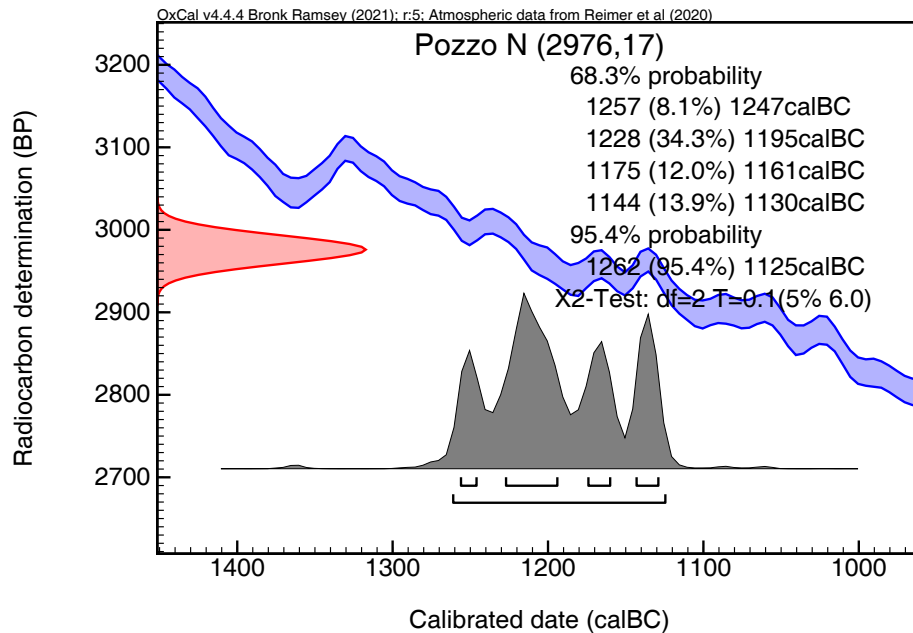


Figure 9. Radiocarbon dates for well N modelled using the OxCal 'Combine' function (Bronk Ramsey 2009) and the IntCal20 calibration curve (Reimer *et al.* 2020).

Feature κκ – Located close to feature λλ, it yielded a large quantity of grape seeds and other plant remains (Ucchesu *et al.* 2025), along with a small number of ceramic fragments. Though not yet fully studied, the diagnostic ceramic material seems to date to the Recent Bronze Age. Dimensions: 0.90 m in diameter and 5 m deep (Figures 2, c; 4, a).

Feature λλ – This structure was modified in antiquity. Initially dug as a well (likely during the Recent or early Final Bronze Age), it was later abandoned and backfilled. In a later phase (Final Bronze Age–Early Iron Age?), the upper part was expanded and repurposed as a pit, possibly for settling clay. This produced a deposit (archaeological context US 1020) which is rich in fragments. The remaining archaeological contexts (US 1023–US 1026) contain limited quantities of pottery, mostly from the Recent Bronze Age. Dimensions: 1.05 m in diameter and approximately 4.70 m deep (Figures 2, c; 4, b–c).

Chronological phases and materials

The ongoing study of the archaeological material recovered from the features and wells in both the Northern and Southern Sectors of the site currently allows for a fairly clear understanding of the development of ceramic production through the various phases. It also helps to some extent in documenting the economic activities carried out at the settlement.

In the features attributed to the Middle Bronze Age (β, γ, γ1, χ², wells U and V), only a few ceramic classes are found, and these primarily consist of open and relatively simple forms. Among the most frequently found categories are flat dishes, baking trays and pans, which show a wide range of shapes and sizes, as well as large bowls, hemispherical bowls, and cups. Carinated bowls are less common. Most of the closed forms are globular jars with a distinct thickened rim or a short, slightly flared neck.

The wells κκ, λλ, and N, which appear to have been constructed in a later phase of the settlement – between the Recent Bronze Age and the Final Bronze Age – have yielded a significantly greater variety of forms than those known from the earlier phase. They attest a progressive decline in forms such as the pan and the globular-bodied jar, alongside the appearance of jars with thickened rims, carinated bowls with pierced lugs, cups, bowls with rims wider than their carination, bowls with inward-curving rims

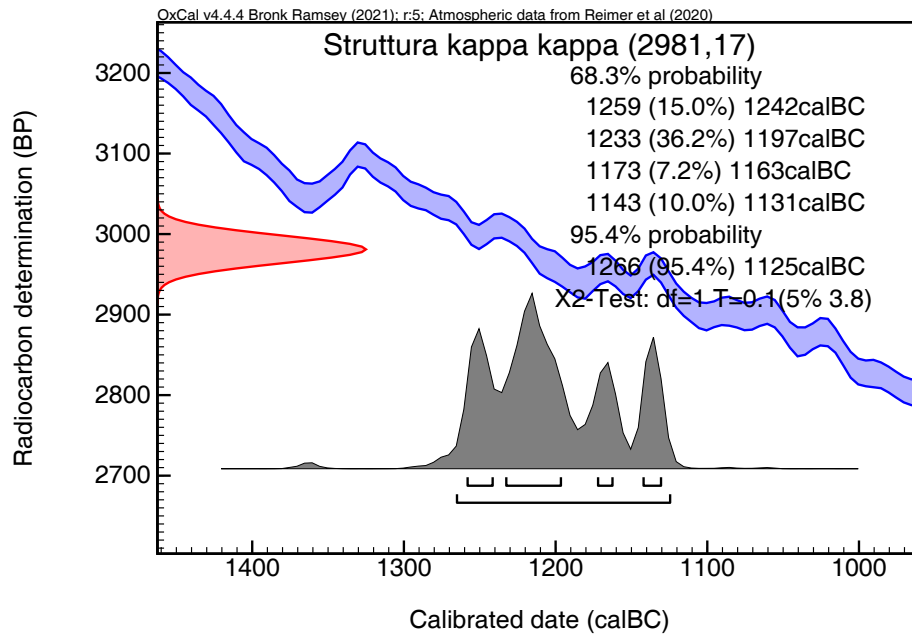


Figure 10. Radiocarbon dates for feature κκ modelled using the OxCal 'Combine' function (Bronk Ramsey 2009) and the IntCal20 calibration curve (Reimer *et al.* 2020).

and horizontal handles, vessels with well-developed necks, jugs, amphorae, and non-vessel forms such as heart-shaped lamps, portable cooking equipment and fire-dogs. Net weights are found in high numbers in various features and wells attributable to the Recent and Final Bronze Age and are of particular importance for reconstructing the economy of the settlement, as they are not found in Middle Bronze Age contexts.

Radiocarbon chronology

Seventeen radiocarbon dates are available for eight structures at Sa Osa and, importantly, 11 of these were determined on short-lived samples (six seeds, four bones and a tooth) (Figures 7–8). The oldest dates relate to feature γ1 (archaeological context 526 – Fi-2953: 3240 ± 70 BP, which calibrates to 1731–1321 cal BC at 95.4% probability), and feature V (archaeological context US 434 – DSH-2643: 3223 ± 32 BP, which calibrates to 1537–1422 cal BC at 95.4%). The former, Fi-2953, is a bone sample, while DSH-2643 was sampled from an olive branch (Martinelli and Pignatelli 2011: 7, 12), and is unlikely to be affected by the old-wood effect. Calibrated at 68.3% confidence, these two dates suggest that the earliest dated structures at the site can perhaps be dated to 1609–1433 cal BC (γ1) and 1510–1447 cal BC (V), the Middle Bronze Age. As noted above, the pottery from these two archaeological features is also datable to the Middle Bronze Age, but as discussed below, US 434 in well V contains material with later radiocarbon dates.

Most of the rest of the dates cluster in the second half of the second millennium cal BC. In three cases we have multiple dates from the same feature: N, κκ and V. The three dates from archaeological context US 171 in N (OxA-25106, Beta-345402 and OxA-25107) document the cultivation of grape vines (*Vitis vinifera* L.; Uccesu *et al.* 2015b, 2025) and melon (*Cucumis melo* L.; Sabato *et al.* 2019) in the Recent or early Final Bronze Age. On the grounds that these three dates, which are all from the same excavation context, are highly likely to be contemporary, we performed a Bayesian model on the dates using the 'Combine' function of OxCal (Bronk Ramsey 2009), which provided a modelled date for the context of 1262–1125 cal BC at 95.4% confidence (1257–1130 cal BC at 68.3%) (Figure 9).

The two dates from κκ, on the other hand, come from a feature that, on the grounds of its uniform material culture, was likely filled over a very brief period of time. We therefore again performed a Bayesian model using the ‘Combine’ function of OxCal. The model for the two dates (Beta-667692 and DSH-6992_S) is statistically robust and therefore adds weight to this hypothesis, suggesting that this fill event took place at 1266–1125 cal BC at 95.4% confidence (1259–1131 cal BC at 68.3%) (Figure 10). Interestingly, the modelled dates for N and κκ overlap and suggest activity at this time in both the northern (features labelled with Greek letters) and southern (features labelled with Roman alphabet letters) sectors of the site.

The four dates from archaeological context US 434 in feature V are more problematic as they document a very wide chronological spread (Figure 8): DSH-2643, the earliest, calibrates to 1537–1422 at 95.4% confidence (and therefore falls in the Middle Bronze Age), while Beta-369366 calibrates to 1391–1130 cal BC at 95.4% confidence (in the Recent Bronze Age), with no overlap between the two. We have seen that DSH-2643, a sample on an olive branch, is unlikely to suffer from the old wood effect. The other two dates from context US 434, DSH-2641 and DSH-2637, relate to samples taken from the interior and exterior of a worked piece of fig tree (*Ficus carica* L.) wood; they were modelled using the OxCal D-Sequence function (Bronk Ramsey 2009) giving 891–789 cal BC at 95.4% (828–799 cal BC at 68.2%), a date in the Early Iron Age (Martinelli and Pignatelli 2011: 4–6, 12). If just one date had proved to be an outlier, this could have been simply explained as the result of laboratory error (for a succinct discussion of this issue, see Bowman 1990: 38–42), but the observed pattern requires some reflection. The pottery recovered from feature V can be ascribed to the Middle Bronze Age (Usai *et al.* 2012: 777) and so the samples with later dates are likely to be the result of some sort of disturbance that could not be detected during the excavation.

Finally, two dates (Fi-3010, a sample from US 522 in γ, and Fi-3013, US 1018 in λλ) are outliers with wide uncertainties (2500 ± 130 BP and 2300 ± 170 BP) because the bones sampled contained very little collagen, and what was present was of poor quality. They do not seem to correspond with the material culture of their contexts, and we therefore do not consider them to be accurate.

Final remarks

Sa Osa is important for a number of reasons, as the only extensively excavated Nuragic Bronze Age settlement, as a site without stone structures or a nuraghe, because it has given important palaeobotanical evidence, not least for early cultivation of *Vitis vinifera*, but also because it has been extensively radiocarbon-dated, using primarily short-lived samples. Radiocarbon dates from well-documented contexts are rare for Sardinian prehistory, and even fewer sites have series which permit Bayesian modelling, so Sa Osa lays the foundations for future research.

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The Early Bronze Age settlement of Asparn-Schletz/Lower Austria. A site in the light of quantitative methods

Elisabeth Rammer¹

Abstract

The site Asparn-Schletz is located in the district of Mistelbach/Lower Austria. From 1883 to 1988, 1990 to 2005 and in 2024 archaeological excavations were carried out here. The remains of a multi-phase settlement were uncovered, the oldest traces of which date back to the Linear Pottery. Graves from the Migration Period and traces of a Bronze Age settlement were also uncovered. The Bronze Age phase of the site can be attributed to the Únětice Culture. There are indications that an even finer relative chronological classification could be possible. Quantitative methods (seriation, correspondence analysis) will now be used to determine the exact chronological position of the site and to analyse its relationship to the already known sites of this culture. The finds and features from the Asparn-Schletz as well as the data sets on the Early Bronze Age already entered into the Montelius image database, the programmes MonteliusEditor (for creating the typology) and Winserion (for carrying out quantitative analyses) linked to the image database form the basis for this work.

Key words: Early Bronze Age, Únětice Culture, Lower Austria, seriation, correspondence analyses

Résumé

Le site d'Asparn-Schletz est situé dans le district de Mistelbach, en Basse-Autriche. Des campagnes de fouilles archéologiques y ont été menées de 1883 à 1988, de 1990 à 2005, ainsi qu'en 2024. Les vestiges d'un habitat polyphasé ont été mis au jour, dont les traces les plus anciennes remontent à la culture à céramique linéaire (LBK). Des sépultures de la période des Grandes Invasions ainsi que des vestiges d'une occupation de l'âge du Bronze ont également été découverts. La phase du Bronze ancien du site est attribuée à la culture d'Únětice. Certains indices suggèrent qu'une classification chronologique relative encore plus précise serait possible. Des méthodes quantitatives (sériation, analyse factorielle des correspondances) sont ici employées pour déterminer la position chronologique exacte du site et analyser ses relations con les gisements déjà connus de cette culture. Cette étude se fonde sur les découvertes et les structures d'Asparn-Schletz, ainsi que sur les ensembles de données du Bronze ancien déjà intégrés dans la base de données d'images Montelius. Les logiciels MonteliusEditor (pour l'élaboration de la typologie) et Winserion (pour les analyses quantitatives), liés à ladite base de données, constituent les outils fondamentaux de ce travail.

Mots-clés: Bronze ancien, culture d'Únětice, Basse-Autriche, sériation, analyse des correspondances

Introduction

The site Asparn-Schletz is located in the north of Lower Austria, in the political district of Mistelbach. From 1883 to 1988 and from 1990 to 2005, archaeological excavations were carried out here under the direction of H. Windl (Windl 1983 – 1995 + 2002). The excavations, which had been interrupted until then, were resumed in 2024.

The remains of a multi-phase settlement were uncovered, the oldest traces of which date back to the Linear Pottery. The most famous findings to date can be attributed to this timeperiod. It is a double ditch system, at the bottom of which the remains of more than 100 slain individuals were found. The find has so far been interpreted as one of the oldest pieces of evidence of warfare in Lower Austria (Windl 1996). The ditch system encloses an area of more than 9 hectares (Lenneis 2017: 57). The relationship between the Linear Pottery settlement at Asparn-Schletz and contemporaneous sites in the surrounding area was recently investigated in more detail as part of the citizen science project 'United by Crises', carried out by Franz Pieler (Lower Austrian State Museum) and Julia Längauer (University for Continuing Education Krems) in cooperation with the Museum of Natural History Vienna (Fehlmann and Längauer 2021).² However, more recent findings are also of no small importance.

¹ Universität für Weiterbildung Krems; Elisabeth.Rammer@donau-uni.ac.at

² See also: <https://www.united-by-crisis.at/> (retrieved on 25 June 2024); <https://www.united-by-crisis.at/team> (retrieved on 25 June 2024); <https://www.united-by-crisis.at/partners> (retrieved on 25 June 2024).



Figure 1. Position of Asparn-Schletz in Lower Austria (© atlas.noe.gv.at, Basemap).

Graves from the Migration Period and traces of a Bronze Age settlement were also uncovered. The latter period forms the basis of the work described here.

The Early Bronze Age

The Early Bronze Age settlement phase is primarily characterised by pits with a trapezoidal cross-section. These occur primarily in the northern half of the area investigated by excavations to date. The discolorations 347, 349, 353, 354, 360 (section 21), 704 (section 33), 725 (section 35) and 789 (section 37) can be mentioned here as examples (Figure 2). However, there are also pits with rectangular to square cross-sections, such as pit 358 (section 21). Traces of the Early Bronze Age are thus known from sections 7, 20, 21, 33, 35 and 37 (Rammer 2024).

The pottery material is characterised by thick fragments of pots with fingerprint roughening on the body as well as fine pottery decorated with lines and knobs. This clearly identifies Asparn-Schletz as a settlement of the Únětice Culture. Horizontal lines, from which multi-part bundles of lines lead vertically downwards, dominate the picture here (e.g., UF-19463.12057.2, pit 704. UF-19463.3777.2, pit 361) (Figure



Figure 2. P704, Section 35 (Photograph © Landessammlungen Niederösterreich).

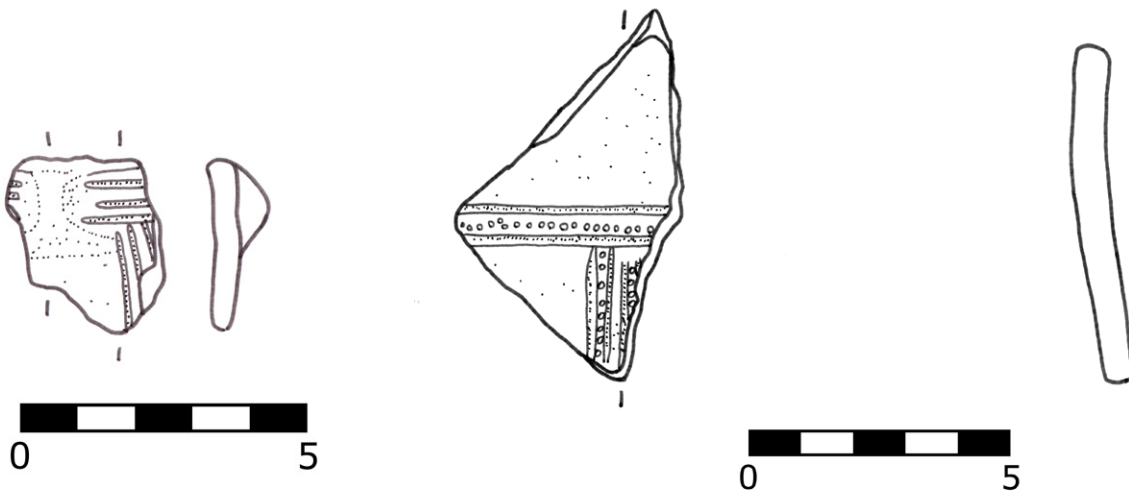


Figure 3. Decorated sherd UF-19463.12057.2, P704 (Drawing © Landessammlungen Niederösterreich, Rammer, E.).

Figure 4. Pottery of the Early Bronze Age, line-decoration (UF-19463.11207), P630 (Drawing © Landessammlungen Niederösterreich, Rammer, E.).

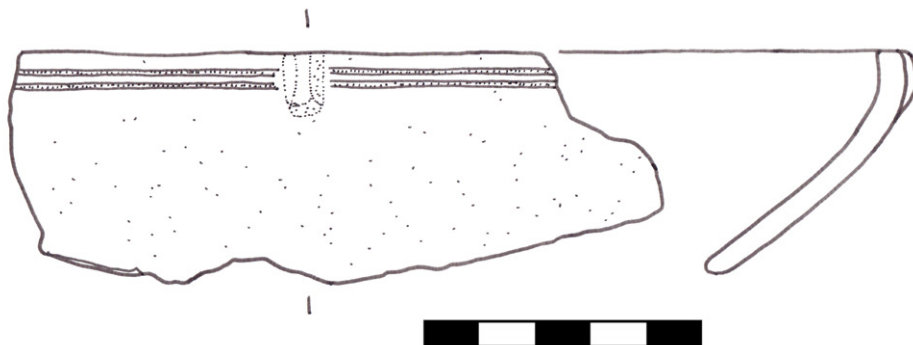


Figure 5. Fragment of a bowl of the Únětice Culture (UF-19463.12057.12061.1), P704 (Drawing © Landessammlungen Niederösterreich, Rammer, E.).

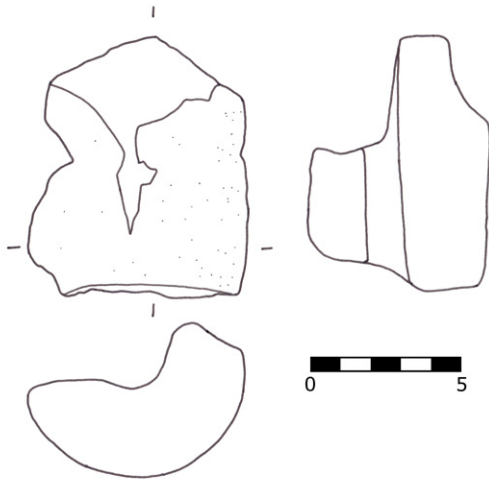


Figure 6. Cylindrical loom weight UF-19463.11208, P630
(Drawing © Landessammlungen Niederösterreich,
Rammer, E.).

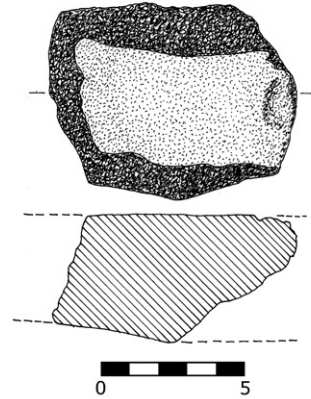


Figure 7. Granting plate, UF-19463.3871, P354
(Drawing © Landessammlungen Niederösterreich).

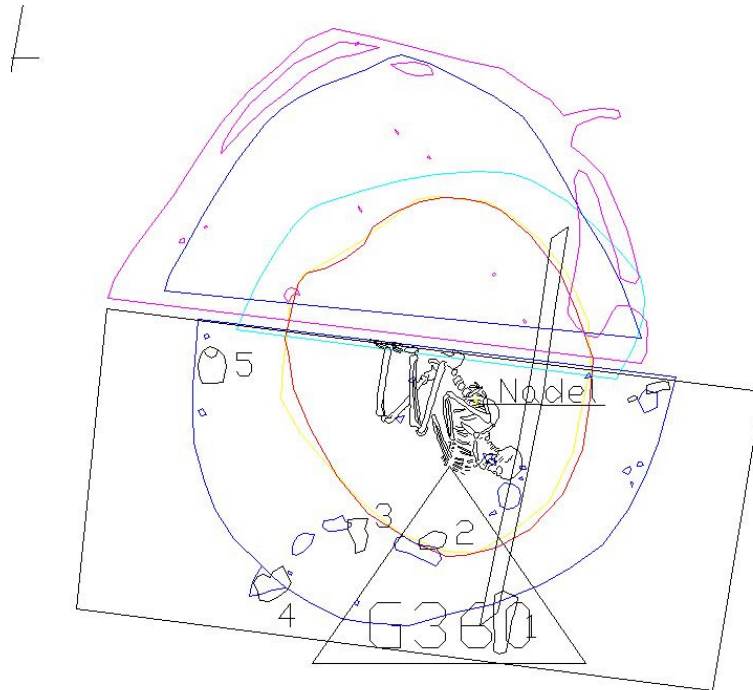


Figure 8. Settlement burial of the early bronze age in pit 360, Section 21
(Drawing © Landessammlungen Niederösterreich).

3). Vertical and horizontal rows of dots lined by lines are also represented (e.g., UF-19463.11207, pit 630). Horizontal double lines, which can be interrupted by knobs (e.g., UF-19463.12057.12061.1, pit 704), are equally typical for the Únětice Culture and were therefore found in Asparn-Schletz (Figure 4). Bowls with conical bodies (see again UF-19463.12057.12061.1) or pots with double-conical bodies (e.g.: UF-19463.3754, see below) are characteristic for this period and region likewise (Figure 5).

Also worth mentioning here are cylindrical loom weights (for example pit 630, UF-19463.11208) and weed grinders (e.g.: pit 354, UF-19463.3871), which underline the settlement character of the site (Figures 6–7).

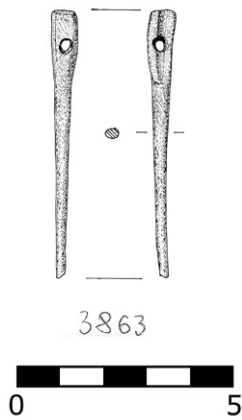


Figure 9. Needle made of bone (UF-19463.3863), P360 (Drawing © Landessammlungen Niederösterreich)

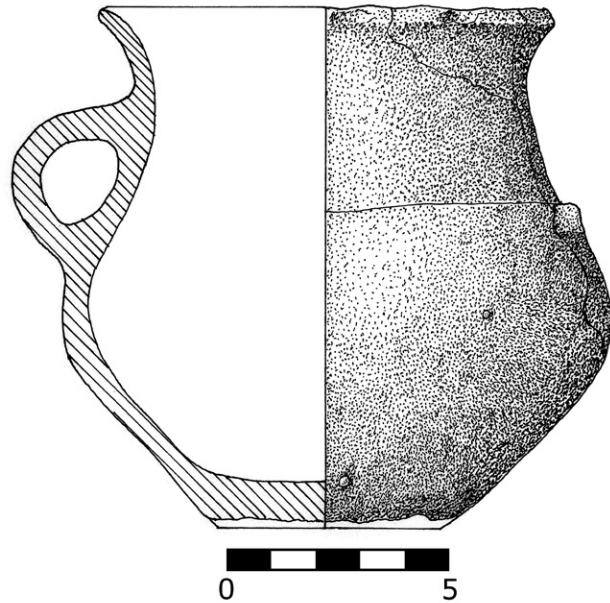


Figure 10. Small pot, Únětice Culture (UF-19463.3754), P360 (Drawing © Landessammlungen Niederösterreich).

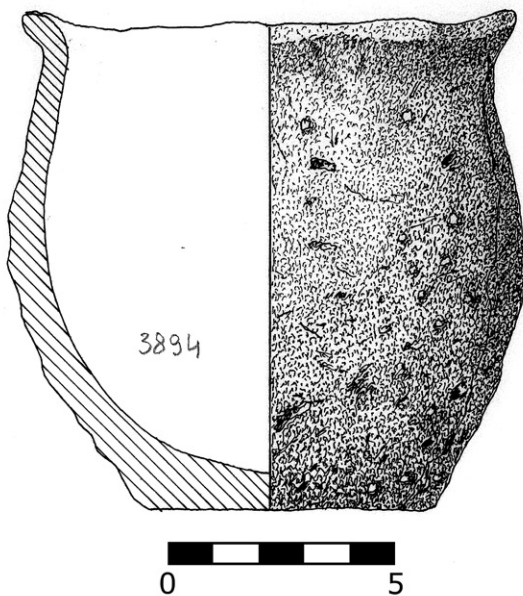


Figure 11. Pot with a barrel-shaped body (UF-19463.3894), P360 (Drawing © Landessammlungen Niederösterreich).



Figure 12. Ceramic bead (UF-19463.3834), P360 (Photograph © Landessammlungen Niederösterreich).

Among the special finds are two settlement burials, each of which was found individually in a pit (pits 360 and 788) in a squatting position and lying on the left side of the body. Both burials lay at the bottom of the trapezoidal settlement pits. As is often the case with such burials, only a small number of grave goods were present (Langová and Danielisová 2013; Lauermaun 1991). In pit 360, for example, fragments of two bone needles were found. A further, complete, pin (UF-19463.3863) was discovered in the chest area of the individual and can therefore be interpreted at least, as a grave goods item, if not as a trach component. Also at the bottom of the pit a small pot with a double-conical body and a knob opposite the base of the handle (UF-19463.3754) was encountered. As this object is completely preserved, it is also interpreted as a grave good. The same applies to the pot with a barrel-shaped body and 3 protruding knobs (UF-19463.3894), which was found directly next to the skeleton according to the note on the find slip (Figures 8–11). Also worth mentioning here is the

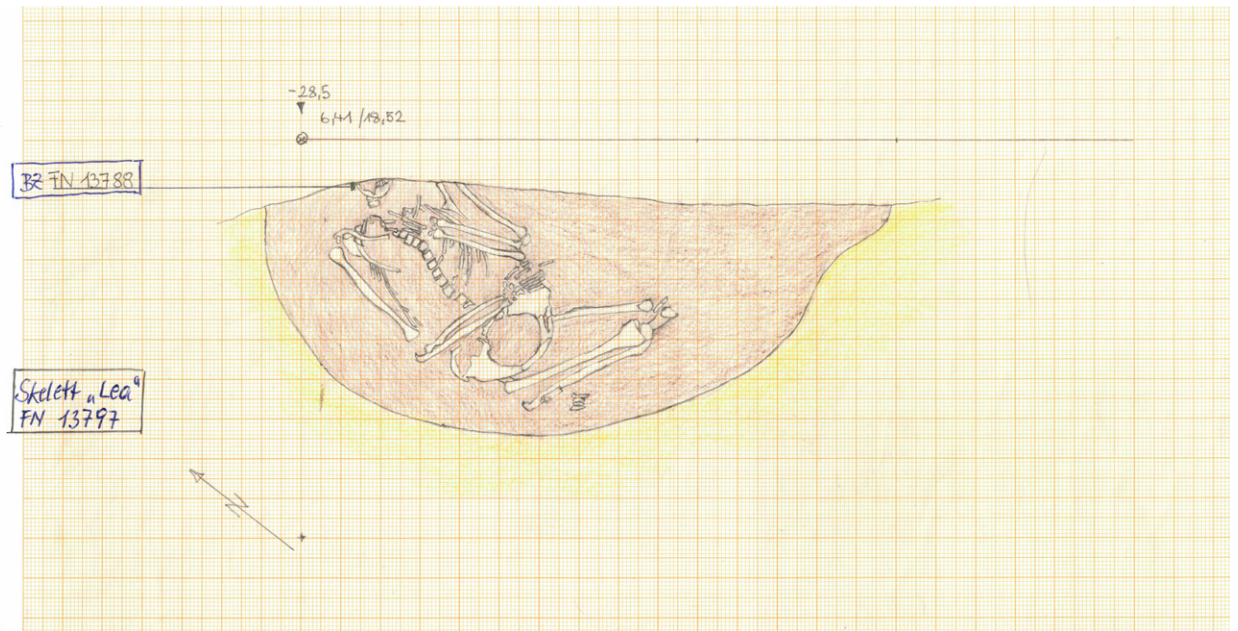


Figure 13. Settlement burial in pit 788, Section 37 (Drawing © Landessammlungen Niederösterreich).



Figure 14. Burl ring made of Bronze (UF-19463.13788), P788 (Photograph © Landessammlungen Niederösterreich).

rare find of a round ceramic bead (UF-19463.3834.3) (Figure 12). Unfortunately, the precise location of the object was not documented, which is why the exact affiliation to the buried individual can no longer be determined. The number of objects which can be assigned to the individual buried in pit 788 was even smaller. Only a burl ring (UF-19463.13788) was found in the area of the temple, otherwise there were no other grave goods (Figures 13–14). The feature was dated on the basis of the few pottery sherds that could be assigned to its backfill. This was possible because pit 788 also contained a pot fragment (UF-19463.13801) which appeared to belong to the younger phase of the Únětice Culture (compare Neugebauer 1994: 109, fig. 55b/25; 120, fig. 62a/17) (Figure 15). In pit 704, on the other hand, the remains of a vessel with low knobs on the inside were found (Figure 16). This is hardly known among finds from the Únětice Culture and only appears more clearly from the Věteřov Culture onwards in Lower Austria (Compare Neugebauer 1994: 130, fig. 68/26).

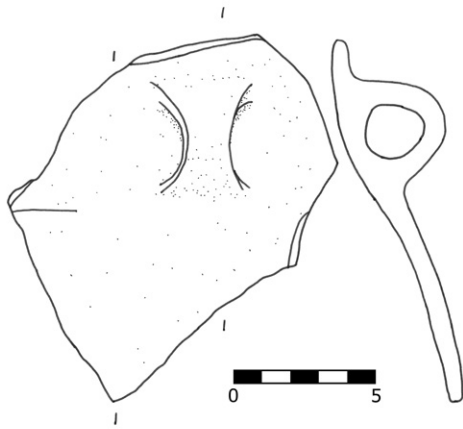


Figure 15. Sherd of a pot of the late Early Bronze age (UF-19463.13801), P788 (Drawing © Landessammlungen Niederösterreich).

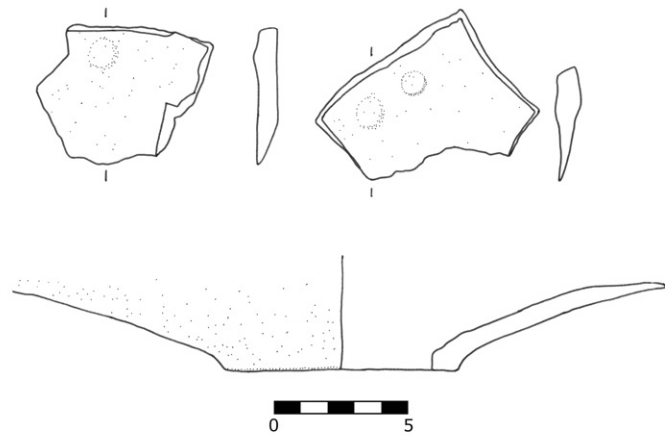


Figure 16. Sherd of a vessel with lugs on the inside, P704 (Drawing © Landessammlungen Niederösterreich, Rammer, E.).

Anthropology

The anthropological investigations of the known Early Bronze Age settlement burials from Asparn-Schletz have not yet been fully completed.³ According to initial results, the burials from the pits 360 and 788 are both female individuals. The age at death can be given as 50–65 years (pit 360) and 50–60 years (pit 788). Evidence of osteoporosis and tooth loss during their lifetime, especially in the latter individual, emphasises the high age at death.

Methods

In order to clarify the question of the chronological position of the Asparn-Schletz site, the find types represented here were included in quantitative analyses (seriation and correspondence analysis) carried out with the help of the Montelius image database and the associated WinSerion programme (Stadler 2005).

‘Montelius’ is an Excel-based image database programmed and created by Dr Peter Stadler of the Natural History Museum Vienna (Rammer 2021; Stadler 2005). Using the associated programmes MonteliusEntry, MonteliusEditor and Winserion, it is possible not only to query individual objects, but also to carry out further quantitative analyses. Generally speaking, the basis of this method is the comparison of individual objects and/or features with each other and the formation of groups based on their similarities or differences. In order to be able to make comprehensible and valid statements here, it is urgently necessary to define a uniform basic set of parameters, which *must* be recorded for each individual archaeological object or feature contained in the database. The individual finds are entered into Montelius using the MonteliusEntry programme. Its input mask also ensures the aforementioned basic data collection (Figure 17). Information on the origin (down to the individual find), the type of find location (settlement, cemetery, etc.), the raw material, the object type, but also the publication in which the item was published are essential here. For burials, indications on the biological sex and presumed age at death is also provided – if known – in order to enable investigations into gender- and age-specific burial objects and rites via the database. As this is an image database, it is also essential to

³ For the whole section: First results of the anthropological investigations done by M. Teschler and F. Nowotny, Naturhistorisches Museum Wien. Rammer 2024, in print.

The screenshot shows the 'Eingabe der Daten zum Bild:' (Data input for the image) window of the MonteliusEntry program. The interface is organized into several sections:

- Top Section:** Includes fields for 'Kultur' (Aunjetitz), 'Thesaurus' (Urgeschichte), 'Index' (12222), 'von' (1242), 'Gesamt' (26751), and 'Date' (18.08.2008). There is a 'Suche!' (Search) button and a 'MonteliusEntry' logo.
- Metadata Section:** Contains 'Code', 'Region' (Lower Austria), 'Fundort Typ' (Einzelgrab), 'SitesNumber' (80410), 'Land' (Austria), and 'Fundort' (Unterhautzentral Leimgrube).
- Complex Section:** Includes 'Komplex' (V023), 'Geschlecht' (M), 'Alter' (M), 'Numerisch' (30), and 'Alter1 - Alter2' (50).
- Prefix Section:** Includes 'Prefix' (Numerisch: Alphanumerisch), 'Tafel Abbildung etc' (Open Scan), 'Abbildung' (AlphaMode), 'Tafel zu Öffnen' (Verb.1, Verb.2, Verb.3), and 'Tafel in MonteliusA' (017).
- Anzahl Section:** Includes 'Anzahl' (1), 'Komment' (Bestattung auf Grubenboden), 'Typen' (Haupt Typ, Untertyp), and 'Material'.
- Zitat Section:** Includes 'Zitat' (LauermannE_1991a), 'Charge' (12), 'Modi' (Normal-Tafel, Komplex), and 'Sortiere nach' (Zitat, Komplex, Datum Zeit).
- Buttons:** A row of buttons includes 'Speichern', 'Beenden', 'Screen Shot', 'Browse Temp', 'Edit Temp', 'Clear Temp', 'Browse Komplex', 'GoLastError', 'GoNextError', and 'SearchOrphans'.
- Right Panel:** A large window displays a drawing of a human skeleton in a burial position, with various tools and buttons for image manipulation (Bildbearbeitung) like 'Bearbeite', 'Ersetzen', 'Teile', 'Insert from Plate', 'Insert from Temp', and 'Löschen'.
- Status Bar:** At the bottom, it shows 'ScansDir', 'Excel File' (C:\Montelius_Tabellen\Aunjetitz.395.xls), 'ImagePath' (C:\Montelius\Autoren_A-Z\L\LauermannE_1991a\AT\Unterhautzentral Leimgrube\V023\LauermannE_1991a.A017), 'Width: 1137', 'Height: 1197', and 'Dpi: 300'.

Figure 17. Input mask of the image-database Montelius (Graphic: Stadler, P. and Rammer, E.).

include a figure of the object or feature by extracting it from a scan of the original publication. This, in combination with the bibliographical references mentioned above, means that the entered data can be checked quickly and easily, which ensures its high quality. Once the object has been entered into the database, the MonteliusEditor programme can be used to make further refinements and extensions to the basic data, i.e. to create a precise typology. In the case of pottery finds, for example, the input mask provides for an assignment to the categories 'pot', 'cup', 'lid' or similar, but an exact classification of the individual type is not yet possible. This can now be done via MonteliusEditor, as can, for example, a more precise description of the decoration. With regard to the latter, it should be noted that in the course of the analyses of the Únětice Culture it emerged that it should be considered separately from the object that wears it. This is because it can and usually does occur on several different types of archaeological find. Horizontal lines with vertical line clusters do not only appear on cups, but also on pots or bowls. Zigzag lines, on the other hand, adorn both ceramics (Lauermann 2003: fig. 70/4) and metal objects (e.g., daggers) (Točík and Budinský-Krčka 1987: fig. 8/6a). These are only two examples of many. In order to be able to include this common feature in the subsequent analysis, it is necessary to categorise the find twice, once according to the object type and once according to the type of decoration. V. Podborsky and his team also dealt with the statistical evaluation of archaeological finds on the basis of their typology. Even if they were not concerned with the Bronze Age, but with Moravian painted pottery, it must nevertheless be noted that they also observed and realised the necessity of separating object and decoration mentioned before (Podborský *et al.* 1977: Objects: 67–131. Decoration: 136–209). It is not possible to do this separation immediately via MonteliusEntry, but it can be conducted with the help of MonteliusEditor.

Once the data collection and the creation of the typology have been completed, the next step is the quantitative analyses using the WinSerion programme. Several evaluation methods are now possible. A Seriation, correspondence analyses (in general as well as according to the sex of the buried individual) or an Analyses of the N-next neighbours can be done. The Correspondence analysis and the seriation

F=283 T=273 I=1631 I*=5428 OZ=1 AZ=30 LIS= 0.9906 COS= 0.9906 STR= 0.9906 J=1 M=35

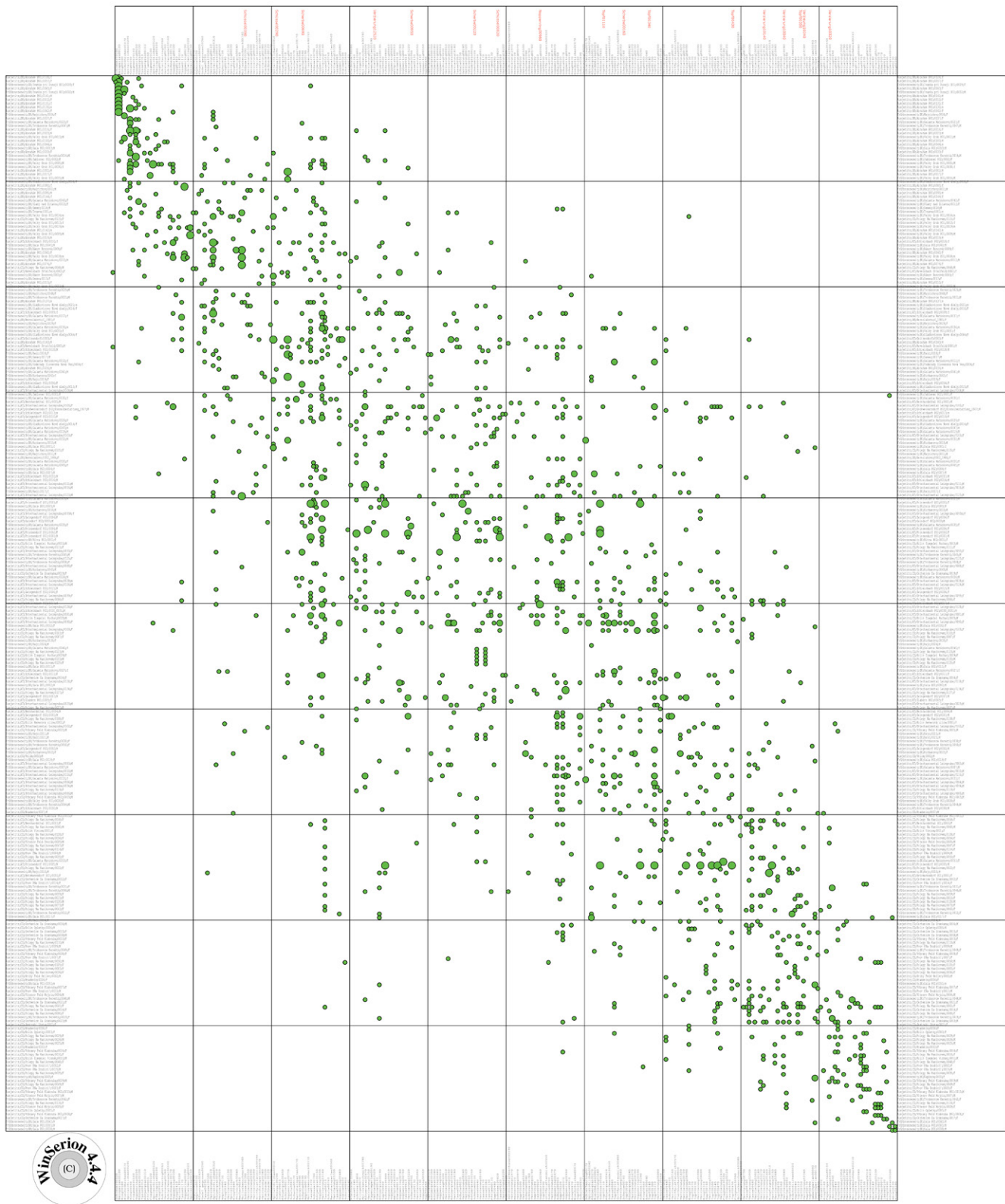


Figure 18. Initial result of the Seriation on the finds and features of the Únětice Culture, including Asparn-Schletz (Graphic: Stadler, P. and Rammer, E.).

To access the full findings please go to <https://doi.org/10.32028/9781805833567-3-Figure18> or scan the QR code:



were primarily relevant for this work and shall therefore be presented in more detail here. In both cases, as described above, similarities and differences are sought in the material used for the analysis.

The basic principle of seriation is that of the ‘closed feature’. The first one who observed this was W.M. Flinders-Petrie (Flinders-Petrie 1899). He assumed that all objects from an archaeological record arrived there at the same time but are not all the same age. Some are slightly older, others slightly younger and the time at which they entered the feature represents the overlapping period in which they existed at the same time. If the contents of several records are compared with each other, a series can be created in this way, from the oldest feature to the most recent. The result is therefore a relative chronological sequence of the archaeological findings used for the comparison. So-called ‘runners’ are an obstacle to this type of quantitative analysis. This refers to types of features and types of objects or decoration that appeared throughout the entire duration of a culture. Although they may be characteristic for it, they do not provide any information about its development over time and must therefore be excluded from this type of analysis.

The primary focus of the results of a correspondence analysis lies on the formation of groups based on similarities between the archaeological finds and features examined. The classifications, which can be observed this way, can have several causes. In the case of burials and cemeteries using a correspondence analysis allows us to identify precisely those gender- and age-specific grave goods that were one of the aims of the research when analysing the finds and features of the Únětice Culture. Local characteristics of a culture can also be determined and defined in this way. However, they may as well be the result of a temporal (and spatial) development, which can be easily verified in combination with a seriation (Lauermann and Rammer 2013: 228–238; Rammer 2024a: 64–83). While overly frequent matches can be a hindrance for creating a relative chronological order (see above), they may be essential for correspondence analysis, as they make it easier to identify affiliations. Extremely rare species or characteristics, on the other hand, are rather unsuitable for this type of analysis, as a lack of comparison possibilities makes it impossible to form groups. The Winsorion programme offers the possibility to exclude types, which have already been defined via MonteliusEditor, but have later proven to be unsuitable for the respective examination method. This can be done individually and separately according to the different types of evaluation.

Results

Asparn-Schletz was integrated into already existing quantitative analyses (Rammer 2017). The aim at the time was to trace the temporal and spatial development of the Únětice Culture and to review previous definitions of gender- and age-specific grave goods.

Including Asparn-Schletz a total of 551 early Bronze Age sites from Germany, Lower Austria, the Czech Republic, Slovakia and Hungary formed the basis for the analyses. Both settlements and cemeteries were used and taken into account for this purpose.

Initial results showed that the Únětice Culture had slowly spread from Slovakia across the Czech Republic and Lower Austria. At first glance, the spectrum of find types represented in Asparn-Schletz shows a wide temporal spread, starting from the first appearance of Lower Austrian sites in the seriation up to the most recent sections.

A closer look reveals that the oldest find types occur for example in features 635 or 796. The youngest find types, on the other hand, are mainly found in discolorations 360, 361, 704, 788 and 789, which also contained the special finds mentioned above. The settlement thus appears to have been utilised over a longer period of time, from the beginning of the Únětice Culture in Lower Austria to its end.

According to the initial results, the types of bowls with cylindrical necks as well as those with conical bodies found at Asparn-Schletz are mainly represented at the beginning of the Únětice Culture. Horizontal double lines and pots with a stepped base are known from their developed, middle section onwards. Five-

part line bundles and pots with a barrel-shaped body or only a gently emphasised neck base only gain importance towards the end of the culture (Figure 18). These results are still to be regarded as provisional, as they must first be verified more precisely by analysing the stratigraphic sequence of the features. However, they do provide an initial indication of what can possibly be expected here. The evaluation of the sequence of features from the Early Bronze Age settlement of Asparn-Schletz is planned for 2025.

The Correspondence Analysis of the grave goods of the two individuals buried in the settlement revealed that both corresponded to the spectrum of sparsely furnished female burials. In the Early Bronze Age men were rather buried in squatting position on the right side of the body (Rammer 2017). Pottery, small daggers sometimes and a rather small number of jewellerys were the grave goods preferred for them. Women on the other hand were buried in a squatting position also, but rather (not exclusively) on the left side of the body. Pottery was also placed in their graves, but it looks as if it was not so much important for them as for the burials of men. Concerning the finds of jewellery female burials also stand in contradiction with men's graves, as it seems to have been of a much greater issue here. In the case of the settlement burials of Asparn-Schletz in addition to the positioning of the body (left-sided stool), the pot with a double-conical body (UF-19463.3754, pit 360) and the bone needles (UF-19463.3868, pit 360) as well as the fragmentary burl ring (UF-19463.13788, pit 788) were decisive factors for the gender-attribution mentioned above. This is also consistent with the results of the anthropological investigations.⁴

Summary

The site Asparn-Schletz is located in the district of Mistelbach in northern Lower Austria. It was archaeologically investigated from 1983 to 1988, from 1990 to 2005 and again from 2024. The structures, which have been uncovered during these investigations show the site to be a multi-phase settlement with the oldest traces dating back to the early Neolithic (Linear Pottery). However, the subject of the investigations described here are the remains of a settlement of the Únětice Culture, which were also uncovered. These are primarily settlement pits with a trapezoidal cross-section, which were found mainly in the northern part of the known settlement area. The finds, especially the pottery, leave no doubt as to the cultural classification of the site. Double lines interrupted by knobs, or bundles of lines leading vertically from horizontal lines across the vessel body, clearly identify this phase of the site as belonging to the Únětice Culture. Cylindrical loom weights and weed grinders emphasise their settlement character. Some of the finds seemed to suggest a date towards the end of the culture represented here. The special finds from Asparn-Schletz include two settlement burials, which were found in pits 360 and 788. Both individuals buried here are older women (minimum age of death 50–maximum 65 years) with only a few grave goods. In order to obtain a clearer picture of the Early Bronze Age section of the Asparn-Schletz settlement site, it was integrated into an already existing quantitative analyses of the Únětice Culture, a seriation and a correspondence analysis. According to their initial results, it spread from Slovakia towards the Czech Republic and Austria. Of all the find types represented in Asparn-Schletz, some already appear in the seriation at the time when the Únětice Culture was first identified in Lower Austria. Others only appear towards the end. This suggests that the site may have been used continuously over a longer period of time during the Early Bronze Age. The features containing the two burials were therefore to be placed at the end of the Únětice Culture. One of the aims of the correspondence analysis was to review the previously valid categorisation of age- and gender-specific grave goods. According to these new investigations, the two settlement burials from Asparn-Schletz fit into the general picture of sparsely furnished women's graves.

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⁴ See footnote no. 2.

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Dynamics of Bronze Age upland settlement in Ireland and Northern Britain in a comparative perspective: Irish results to date

Cherie Edwards¹

Abstract

Bronze Age upland settlement patterns in Ireland and Northern Britain have been interpreted to indicate simultaneous settlement expansion and contraction during periods of palynologically visible climate change. This project focuses on re-assessing existing radiocarbon and paleoenvironmental data to examine comparative chronologies, including radiocarbon datasets generated using newly excavated material. Preliminary conclusions for the Irish data show misalignment between localized palaeoenvironmental patterns and those proposed more generally across the island, indicating regionalized environmental conditions. Settlement and land use persisted on a localized basis regardless of climatic shifts. Settlement occurs c. 2450 BC until c. 350 BC, with an observable hiatus seen c. 2200–1950 BC; hilltop or high-density settlements have the broadest continuum of occupation. Preliminary comparative analysis indicates that settlement patterns in upland Ireland were not correlated with climate transitions, however the paucity of dates and a Late Bronze Age dataset that falls on the Hallstatt Radiocarbon Plateau complicate granular interpretation.

Key words: Bronze Age, Ireland, settlements, uplands, climate

Résumé

Les modèles d'occupation des terres hautes à l'âge du Bronze en Irlande et dans le nord de la Grande-Bretagne ont été interprétés comme l'indice d'une expansion et d'une contraction simultanées de l'habitat lors des périodes de changements climatiques identifiées par la palynologie. Ce projet se concentre sur la réévaluation des données radiocarbone et paléoenvironnementales existantes afin d'examiner les chronologies comparées, en incluant des séries de datations issues de matériels récemment mis au jour. Les conclusions préliminaires pour les données irlandaises révèlent un décalage entre les modèles paléoenvironnementaux locaux et ceux proposés à l'échelle de l'île, soulignant ainsi l'existence de conditions environnementales régionalisées. L'occupation du sol et l'habitat ont persisté sur une base locale indépendamment des fluctuations climatiques. L'occupation s'étend d'environ 2450 av. J.-C. jusqu'à 350 av. J.-C., avec un hiatus observable vers 2200–1950 av. J.-C. ; les habitats de hauteur ou à forte densité présentent la continuité d'occupation la plus large. L'analyse comparative préliminaire indique que les modèles d'établissement dans les hautes terres d'Irlande n'étaient pas corrélés aux transitions climatiques ; toutefois, la rareté des dates et un ensemble de données pour l'âge du Bronze final correspondant au plateau radiocarbone de Hallstatt complexifient toute interprétation granulaire.

Mots-clés: Âge du Bronze, Irlande, habitats, terres hautes, climat

Introduction

The impacts of climate change in the current era have raised questions about the parallels between the vulnerability of our own society and that of past societies to changes in climate (Anderson 2001; Besley and Peters 2020; Butzer 2012). How environmentally climate responsive were societies? What role did climate changes play in how communities approached subsistence or where they lived? Can identifying and understanding patterns in the past inform social resiliency in the present? Questions like these have driven research frameworks as science looks to draw connections with our prehistoric ancestors. The concept of 'upland abandonment' in Ireland and Northern Britain has been the subject of broad attention and debate since first being proposed by Burgess in 1985 (Briggs 1985; Burgess 1985: 195–230; Flemming 1985; Halliday 1985; Jobey 1985; Mercer 1985; McDonald 2023; Pope 2015). Central to Burgess' (1985: 195) theory was the idea that populations in the British Isles during prehistory would have been as vulnerable to disasters as those in the historical era, with the upland zones being particularly at risk due to their additional exposure to the natural elements. Burgess (1985: 195) pointed to c. 1300–1000 BC as a period where 'abandonment of agricultural systems, and dislocation of settlement, cultural, and

¹ Department of Archaeology and Palaeoecology, Queen's University Belfast; cedwards19@qub.ac.uk

burial traditions' took place in both upland and lowland locations, for which he argued that a slump in metals typologically dated to c. 1250–900 BC provided evidence for that shift. Burgess built on the ideas of scholars like Chapman and Mytum (1983: iii), who postulated that field systems and farming spaces should be interpreted as evidence of shifting concepts of land ownership and inheritance; however, Chapman and Mytum (1983: iii) acknowledged that a lack of reliable population density estimates made drawing conclusions about food production 'difficult'. Understanding settlement hierarchies, socio-political functions, and economic place in Bronze Age society became essential research priorities (Chapman and Mytum 1983: v) and were the genesis of theoretical approaches like those presented by Burgess (1985). Burgess (1985: 200) further supported his theory by rolling backwards the Medieval 'Doomsday Book' to calculate the Bronze Age population, asserting that a population in the 'millions' must have effectively vanished, with no visible resurgence until the Iron Age. Burgess' theory found support in other studies on the rise and fall of populations during the Romano-British Iron Age (Cunliffe 2004; Cunliffe 2018).

The evocative landscapes painted as part of this theorized clearance of human occupation were substantiated through hut circle foundations still visible under peat in the blanket bogs of Ireland and upland Britain (Burgess 1985: 201). Despite an acknowledged paucity of radiocarbon dating to support these theories (Chapman and Mytum 1983: iii), and the source of most data originating from Northumberland, Cornwall and Teesdale in England (Burgess 1985: 201), the concept of an upland abandonment at the end of the Bronze Age remained a seminal operating theory within Bronze Age settlement studies. The persistence of upland abandonment theory has generated numerous archaeological and palaeoecological studies (Armit *et al.* 2014; Bishop 2015; Brandherm *et al.* 2023; Briggs 1985; Dark 2006; Davies and Turner 1979; Davies 2007; Dodgshon *et al.* 2000; Doody 2000; Edwards and Mason 2006; Farrell 2015; Fish *et al.* 2010; Flitcroft 2006; Geary *et al.* 2020; Gillie 2003; Ginn 2011; Ginn 2016; Ginn and Plunkett 2020; Halliday 1985; Harding 2012; Jobey 1985; Johnson 2001; Locke and Ralston 2022; Macklin 2000; Mamwell 2017; McCullagh and Tipping 1998; McDonald 2023; McLaughlin *et al.* 2016; Mercer 1985; Milburn 1997; Mount 1996; Murray 2018; O'Brien and O'Driscoll 2017; O'Connell *et al.* 2020; Payne *et al.* 2016; Plunkett *et al.* 2004; Plunkett 2009a; Plunkett *et al.* 2013; Ralston and Ashmore 2007; Raftery 1969; Raftery 1986; Rathbone 2013; Robinson and Dickson 1988; Spencer *et al.* 2020; Stevens and Fuller 2012; Stevens and Fuller 2015; Strachan *et al.* 2004; Swain 1987; Taylor *et al.* 2018; Tipping and Davies 2006; Tipping *et al.* 2008; Tisdall 2000; Tisdall *et al.* 2013; Topping *et al.* 2008; Turney *et al.* 2016; Wang *et al.* 2012; Whitefield 2017). Despite the dearth of information generated from those studies, the attempt to resolve the question of upland settlement abandonment in terms of climactic impacts has not produced any reliably definitive 'yes' or 'no' answers.

The highly localized datasets produced by the aforementioned studies have lacked comprehensive collation or region-wide interrogation, with many of the studies more broadly superimposing conclusions on regions beyond the sampled area. This has hindered the ability to produce an understanding of the nuances between climate and settlement. This disconnect between pollen studies and archaeological settlement data was observed early on by Wilson (1983: 29–54), who remarked that the differences in scientific methods used to evaluate results could lead to the superimposition of data on too broad of an area and therefore result in overly broad conclusions. Wilson (1983: 29) questioned the ability to attribute changes in vegetation to human activity, a position reiterated by Thoms and Halliday (2013: 16) when they observed that patterns identified by Burgess (1985) and others were not universal. More recently Ginn and Plunkett (2020) have advocated for a decrease in settlement more broadly across Ireland from c. 1300–1100 cal BC, with a subsequent renewal from c. 1100–800/750 cal BC. The position reaffirmed the position that the Irish pollen record was consistent with 'a total collapse of society and economy' (Plunkett 2009b: 52) c. 600 BC, which drove a 'radical break up of the existing settlement patterns' (Plunkett 2009b: 53).

To provide clarity on whether settlement abandonment happened during the Bronze Age and if any relation to climate shifts was evident, NERC (National Environmental Research Council) and UKRI (United Kingdom Research and Innovation) funded a QUADRAT Doctoral Training Partnership project focused on evaluating Bronze Age settlement patterns in Ireland and Northern Britain. The two overarching goals of this funded project are: 1) establish if there are identifiable periods of time where Bronze Age

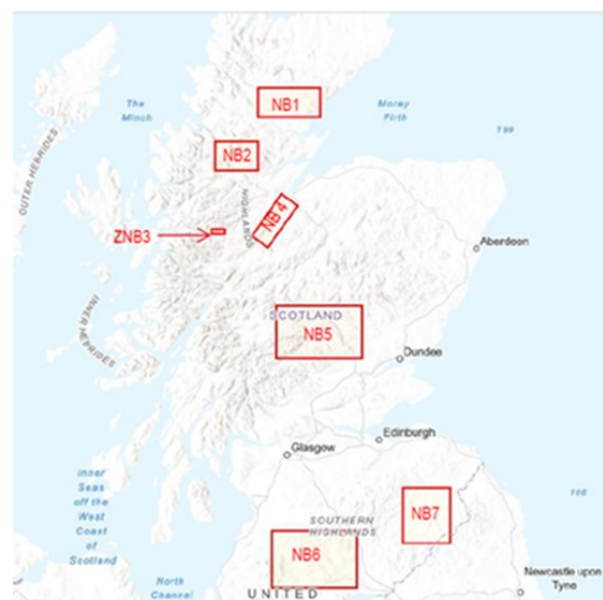


Figure 1. Map showing the general location of the research area (upper), the research area of Ireland by Zones (IRE1-IRE7) and Northern Britain by Zones (NB1-NB7).

settlements in upland areas fall off or experience a hiatus; and 2) compare settlement chronologies against palaeoenvironmental data to evaluate if there are any discernible correlations between climate and settlement patterns. To achieve these goals, the project objectives focus on: 1) refining the radiocarbon chronologies around Bronze Age upland settlements in Ireland and Northern Britain; 2) identification of undated settlements for which radiocarbon testing may be available in order to expand the existing chronology modelling base and proof the date range estimates for known sites; 3) compiling and modelling Bronze Age palaeoenvironmental and palaeoclimatic data on a micro and macro regional level and; 4) assessment of regional results comparatively against each other and against the larger region wide patterns.

Defining the uplands

The vastness of geographical space across Ireland and Northern Britain required that the research area first needed to be spatially constrained into units that would maximize the existing settlement and palaeoenvironmental data. Each region (Ireland and Northern Britain) was therefore divided into Zones (Figure 1) and a uniform definition of ‘upland’ was applied to dataset searches.

Given the wide variations in altitude and topographic features across the study area, the European Economic Community (EEC) definition of upland established by EEC Directive 75/268/EEC was excluded as a defining parameter. EEC Directive 75/268/EEC identifies ‘upland’ only in terms of current economic value based on its farming production output (EEC Directive 75/268/EEC). Outside of the EEC definition, there is no universally agreed-upon definition. Various agencies and groups such as the Ordnance Survey, National Parks and Wildlife Services, the Geological Services, and archaeologists each apply tailored definitions which have changed considerably since 1940 (Bunce *et al.* 2018; Carlier *et al.* 2021: 9; Edwards forthcoming). Using modern farming economics to define the spatial boundaries employed to study prehistoric landscapes fails to recognize that ‘marginality’ is a culturally subjective definition. It applies a false sense of static understanding to how landscapes have been used, valued, or perceived; particularly when one considers the pronounced differences in the arboreal, grassland, and peat coverage that would have been present in prehistory when compared to modern landscapes (Costello 2021; Edwards forthcoming). To avoid using a narrow and unilateral definition of ‘upland’, and to account for the general agreement across disciplines that ‘uplands’ typically represent landscapes of higher altitude more vulnerable to cooler, wetter and windier conditions (Averis 2004: 15), a more broadly general definition has been applied to this study. Upland sites are therefore defined as those that meet or exceed the average topographical elevation within the larger geographic context (for example the County, Townland, District, or Precinct) where they are located. This definition acknowledges that the ‘uplands’ constitute areas of greater altitude and more vulnerable conditions, but without applying a uniform height threshold across individual landscapes that vary widely in their altitude and topography.

Refining radiocarbon chronologies in Ireland: preliminary findings

The 61 reliably radiocarbon dated upland and non-upland settlement sites identified by Ginn (2013) were reaffirmed and used as a baseline dataset in Ireland. To account for sites excavated or radiocarbon dated after 2013, a desk-based assessment of the National Monuments Records (NMR) of Ireland, the Historic Environment Division (HED) of Northern Ireland, and the digital repository of www.excavations.ie (Database of Irish Excavation Reports) was conducted using settlement-based search parameters. These searches produced 2497 sites that were categorized as settlements, hut circles or roundhouses, and assigned a Bronze Age or suspected Bronze Age date. This dataset was filtered to exclude sites that had no radiocarbon dating or where radiocarbon dates were deemed ‘unreliable’. Walterbolk’s (1971) criteria for reliability was used as a minimum threshold for evaluating existing radiocarbon dates for inclusion. Radiocarbon dates based on samples that did not come from a context directly associated with settlement, or where a context could not be reliably determined, were excluded. In keeping with the theory behind single-entity sampling (Bayliss *et al.* 2018: 1144), and to ensure that datasets did not include radiocarbon dates where mean dates rather than actual dates were used, radiocarbon dates were

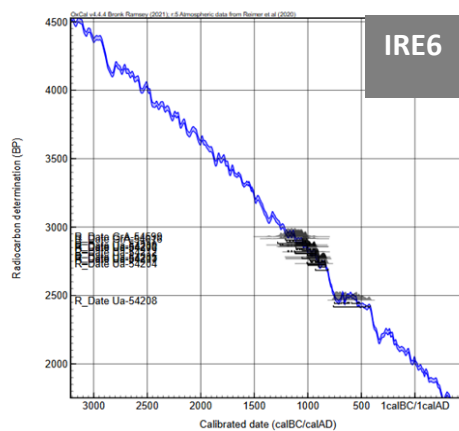
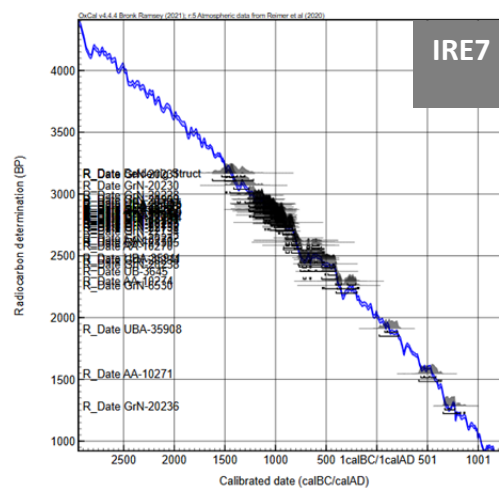
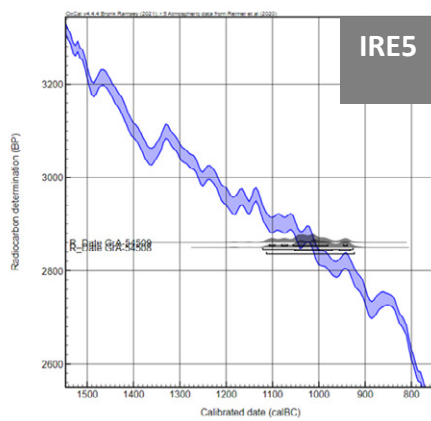
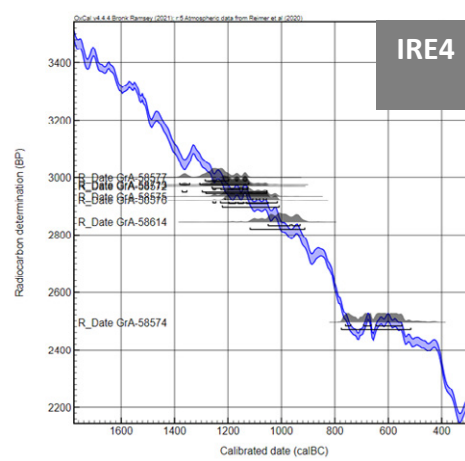
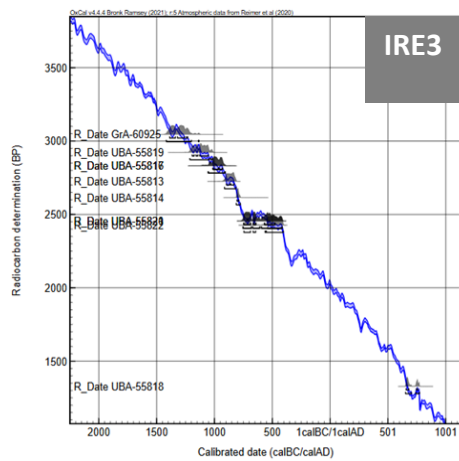
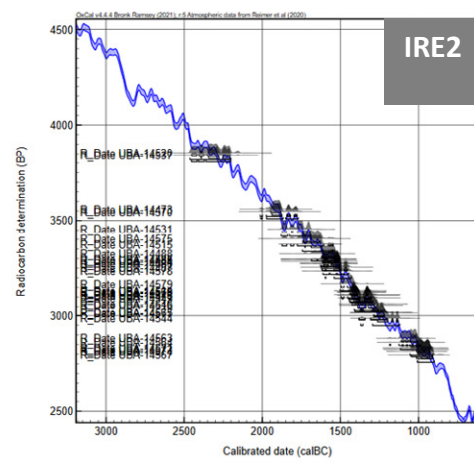
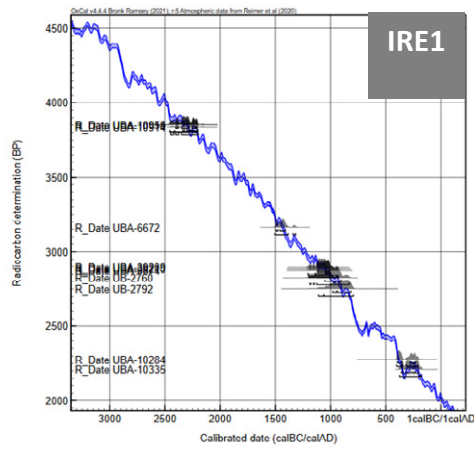


Figure 2. Radiocarbon dates for Ireland plotted by individual Irish research Zone (IRE1-IRE7).

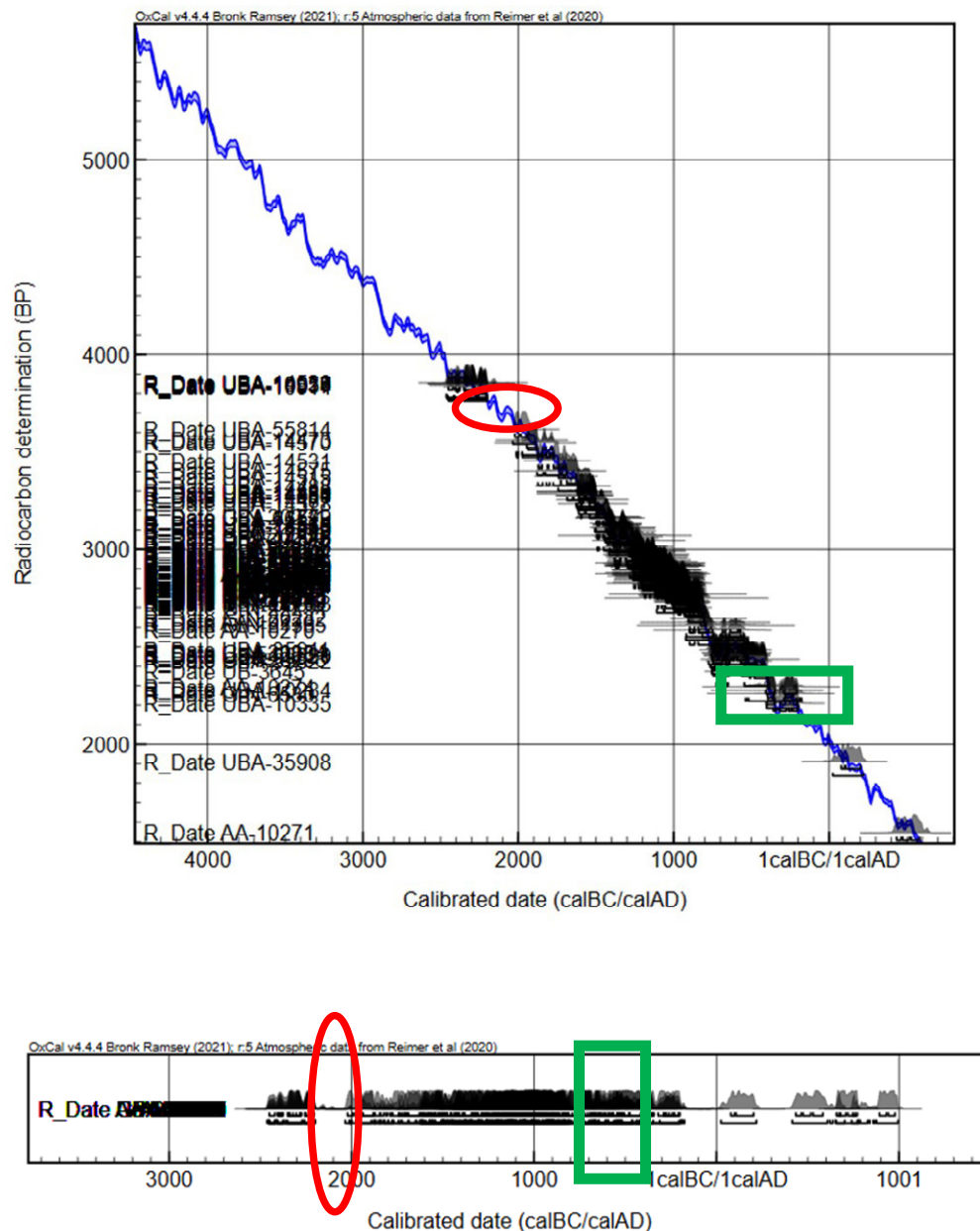
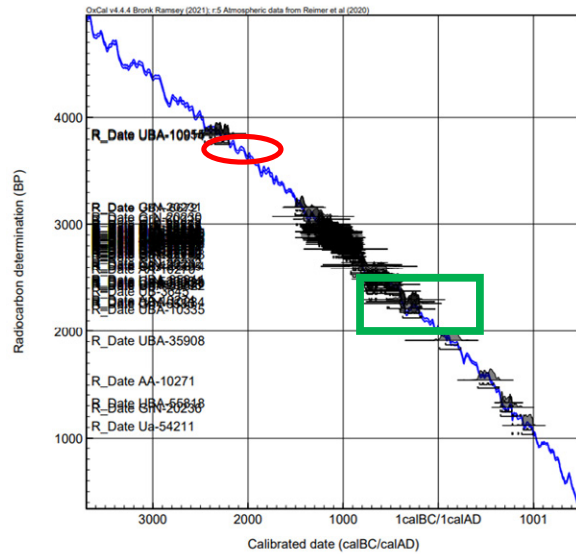


Figure 3. All plotted radiocarbon dates for upland settlements within the research Zones in Ireland. Settlement hiatus seen at c. 2250–200 cal BC is marked by a circle. Dates into the EIA that fall on the Hallstatt Radiocarbon Plateau are marked by a square.

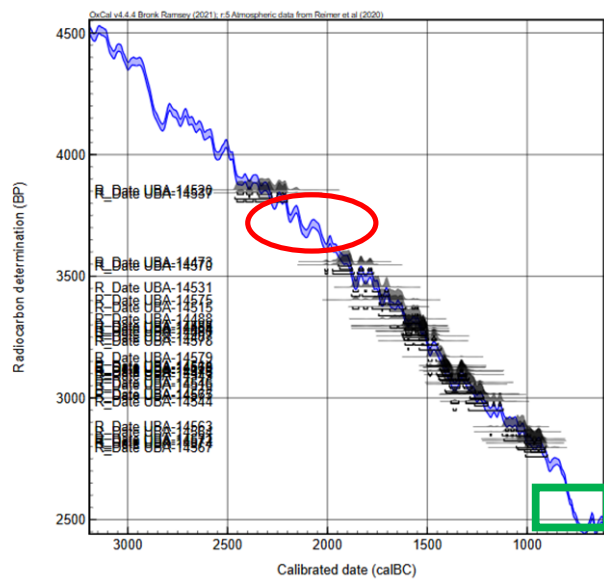
excluded if results had been generated from bulk samples or the sample was not identified by species. To avoid including radiocarbon dates where an inbuilt age error may be present, samples based on oak (*Quercus*) were excluded from modelling datasets. Radiocarbon dates using peat were excluded to eliminate dates derived from samples that still contained humin where the effects of humin or root intrusion could not be accounted for (Alexandrovskiy and Chinchagova 1997; Naysmith *et al.* 2018; Brock *et al.* 2011; Shore *et al.* 1995). Radiocarbon dates generated pre-1973 used the incorrect half-life of 5568, and in some cases radiocarbon labs continued to utilize the old half-life until 1980 (*pers comm* Christopher Bronk-Ramsey; *pers comm* Maarten Blaauw). Due to the inherent unreliability of radiocarbon dates produced using the incorrect half-life, the recommendation that they be excluded (*pers comm* Christopher Bronk-Ramsey) has been followed. Any radiocarbon dates generated pre-1980 were likewise excluded if the use of the correct half-life could not be confirmed. Radiocarbon dates for sites beyond the boundaries



HILLTOP SITES

C. 2450-2205cal BC

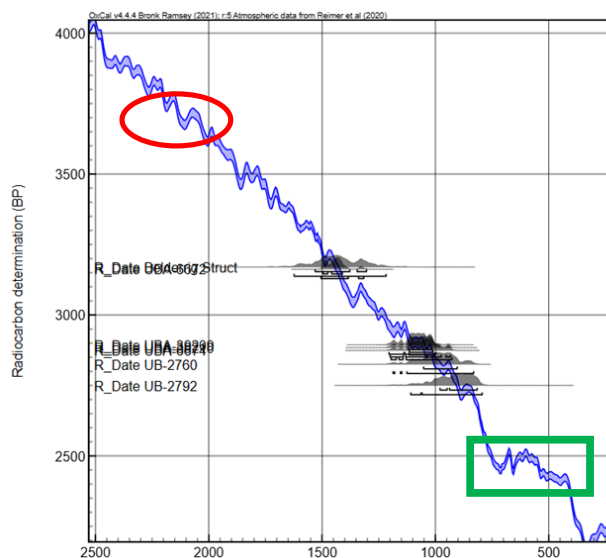
C. 1450-350cal BC



NO VISIBILITY SITES WITH HIGH DENSITY

C. 2450-2200cal BC

C. 1950-900cal BC



HIGH VISIBILITY SITES

NON-HILLTOP

C. 1550-1300cal BC

C. 1200-800cal BC

Figure 4. Plotted radiocarbon dates for IRE1-IRE7 shown by site type. Settlement hiatus seen at c. 2250–200 cal BC is marked by a circle. Dates into the EIA that fall on the Hallstatt Radiocarbon Plateau are marked by a square

of the research Zones were also eliminated. The result was a dataset based on 121 reliable radiocarbon dates from 22 upland Irish sites. Notably, the bulk of reliable radiocarbon dates in Ireland originate from hilltop settlement sites. This is consistent with observations that most excavation data has been returned from sites designated as ‘hillforts’ or lowland settlement sites (Ginn 2016; O’Brien and O’Driscoll 2017), in part due to the combination of academic focus on these areas and the generation of dates which are the by-product of development-based excavation.

All available radiocarbon dates were recalibrated using OxCal Version 4.4 Bronk-Ramsey 2021 (Bronk Ramsey 2009). Datasets were subject to Bayesian modelling by research Zone and as a large single Irish upland dataset. The available dates for each Zone varied considerably, with Zone 2 (Co. Tyrone) and Zone 7 (Counties Mayo, Galway, and Sligo) producing the largest available dataset, while Zone 5 (Counties Cork and Kerry) produced the smallest. Within each Zone, the range of settlement occupation dates has broad variations, with some regions experiencing upland occupation across the larger *durée* of the Bronze Age and others showing only limited periods of occupation (Figure 2). Preliminary analysis of the dataset across all Zones clearly shows upland settlement across the duration of the Bronze Age (BA) and into the Early Iron Age (EIA). There is an observable hiatus of settlements dated to c. 2250–2000 cal BC (Figure 3). To test the validity of this observation, all available upland radiocarbon datasets were modelled, regardless of their sample source or ‘reliability’. This increased the available dataset to 176 dates. The observable hiatus between c. 2200–1950 cal BC remained.

All Zones except IRE5 have radiocarbon evidence for settlement in the EIA period, either as part of ongoing settlement (such as in the case of IRE3 and IRE7) or a return to the location (such as in the case of IRE1, IRE4 and IRE6). IRE3 and IRE7 have datasets offering the clearest chronologies indicating continued use of settlement sites into the EIA, where radiocarbon dated evidence of settlement does not leave the record until the 4th and 5th Centuries BC. IRE1, IRE4, and IRE6 radiocarbon data shows a hiatus between c. 900–850 BC, with a return in occupation in the 4th and 5th Centuries BC; however, the datasets of IRE4 and IRE6 are predominately tightly clustered around the Middle Bronze Age (MBA) c. 1200–850 cal BC, with the EIA dates representing single samples. The single EIA dates are not likely to represent intrusive data given their contexts, however, they may be representative of a lack of a full dataset as a result of the small sample set generated from their respective sites.

IRE1 has a radiocarbon dataset tightly clustered around c. 1250–850 cal BC, with IRE1 and IRE2 being the only upland locations in this study that have produced Early Bronze Age (EBA) radiocarbon dates, suggesting that the sites in this region saw initial occupation c. 2450–2200 cal BC during the Neolithic-Bronze Age (Neo-BA) transition.

There does not appear to be variation in the chronologies depending on the site type (Figure 4): the EBA dates at IRE1 come from a hilltop site, while those in IRE2 come from non-hilltop sites that had no visibility in the landscape before excavation and were found in context associated with pits, gulleys and roundhouse wall slots. Both hilltop sites and those with no landscape visibility have produced the most extensive chronological datasets across the duration of the Bronze Age, with both evidencing the hiatus between c. 2200–1950 cal BC. Non-hilltop sites with high visibility in the landscape suffer from a paucity of reliable radiocarbon dates. However, the available data indicates that they predominately date to the Middle-Late Bronze Age, with the earliest date coming from a single location in IRE7. Preliminary results indicate that non-hilltop high visibility sites are strictly associated with single dwellings found surrounded by extensive relic field wall systems (Edwards forthcoming). Hilltop sites have produced the most extensive chronological date range, indicating sustained occupation from c. 1450–350 cal BC. As hilltop sites with radiocarbon dates represent sites consistent with large-scale nucleated settlements (Bergh 2015; Bergh 2016; Brandherm *et al.* 2018a, 2018b; Brandherm *et al.* 2021; Brandherm *et al.* 2023; McNeary 2014; O’Brien and O’Driscoll 2017; O’Driscoll 2017; O’Driscoll 2023: 26; O’Maolduin *et al.* 2021; Rathbone 2013) and the sites in this study are consistent with the radiocarbon dates from the single known Irish example of a lowland nucleated settlement (Corrstown Village, Co. Antrim) (Ginn 2011, 2012, 2016; Wilson 2012), it may suggest that high density settlement sites were more common during the

Bronze Age than initially believed. Occupation dates at the LBA-EIA transition and into the first two centuries of the EIA fall on the Hallstatt Radiocarbon Plateau. The inherent inability to refine the dates which fall on this section of the radiocarbon curve means that we cannot accurately pinpoint the date when settlements saw abandonment within this period, a problem that is well acknowledged in the literature regarding Irish archaeology (Becker 2012; Becker 2019; Geary *et al.* 2020; Hamilton *et al.* 2019; Haselgrove and Pope 2007; Plunkett *et al.* 2004; Plunkett 2009a). For those that postdate the Hallstatt Plateau we can, however, confidently say that occupation was ongoing post-Bronze Age. In the case of the uplands, the only sites that fall within this category are those situated at hilltop sites.

The consistency of occupation across the Middle Bronze Age and into the Early Iron Age, would suggest that the proposed settlement decreases across Ireland from c. 1300–1000 BC and resurgences c. 110–800/750 BC (Ginn and Plunkett 2020) are not applicable to upland sites; more broadly the presence of higher density sites with continual occupation may account for absences seen in non-upland or non-hilltop/nucleated sites.

Expanding the radiocarbon dataset with newly generated dates

Due to the small number of settlement sites in upland areas that have reliable radiocarbon dates, the need to expand site-based datasets was essential. Refining single site or Zone based chronologies requires Bayesian analysis to generate a more reliable comparative basis when assessing settlement occupation against climate datasets. To generate the most robust dataset possible, existing radiocarbon dates were compiled and where sites did not have the sufficient minimum number of dates to generate Bayesian models, new material was sought for testing. For sites excavated where a record of the archival deposition of the archaeological material was provided, each site was logged into a database with the site name, number, location, date of excavation, and the resting place of the excavation file and artifacts. This database was used to reach out to the National Museum of Ireland (NMI), the Ulster Museum, and the Northern Ireland Historic Environment Division (HED). As a result of the queries, three additional sites are currently under review for possible radiocarbon dating from archival samples.

The project funded, and undertook, excavations at Brusselstown Ring Hillfort in Co. Wicklow in Summer 2024, with two test trenches excavated at locations identified as possible prehistoric house platforms by photogrammetry (O'Driscoll 2017). Both locations returned significant quantities of charcoal and features consistent with prehistoric roundhouses (Brandherm 2024). Radiocarbon samples have been submitted to 14Chrono at Queen's University Belfast and radiocarbon dates will be published accordingly (Brandherm *et al.* forthcoming).

Compiling and modelling palaeoenvironmental and palaeoclimatic data

An attempt to reconcile upland settlement patterns in the absence of more granular settlement chronologies has driven a prolific research framework to collect and analyse palynological data as a proxy for settlement data within Ireland. Pollen diagrams have been used to identify anthropogenic impacts on the prehistoric Irish landscape and to assess correlations between human presence and climatic changes (Jessen 1949; Mitchell 1954, 1956, 1958; Mitchell *et al.* 2013; O'Connell 2021). In Ireland, a particular focus has been in sampling upland areas using peat bogs and lough sediments (Plunkett 2009a; Plunkett *et al.* 2013). Chironomid-inferred temperatures (C-ITs) from data taken in County Donegal in the northwest of Ireland identified spikes of warmer and dryer conditions c. 1260 BC and c. 920–620 BC, with cooler periods being experienced c. 1390 BC and c. 1150–960 BC (Gearey *et al.* 2020: 112). Data from County Tipperary in the central southern portion of Ireland indicated shifts to warmer and dryer weather c. 1250 BC, c. 750 BC and again at c. 600/400 BC (Gearey *et al.* 2020). County Offaly in central Ireland has provided evidence of a shift from wetter to dryer conditions c. 1000–950 BC and c. 980–820 BC (Gearey *et al.* 2020:116) with overall mean July temperatures suggesting rising summer temperatures (Geary *et al.* 2020; Taylor *et al.* 2018). Growth anomalies on bog preserved oak were observed by Ballie and Munro (1988) at 2345 BC, 1628 BC, and 1159 BC. A tephra constrained 'wet shift' is seen c. 800–750 BC (Plunkett *et al.* 2013). However, the

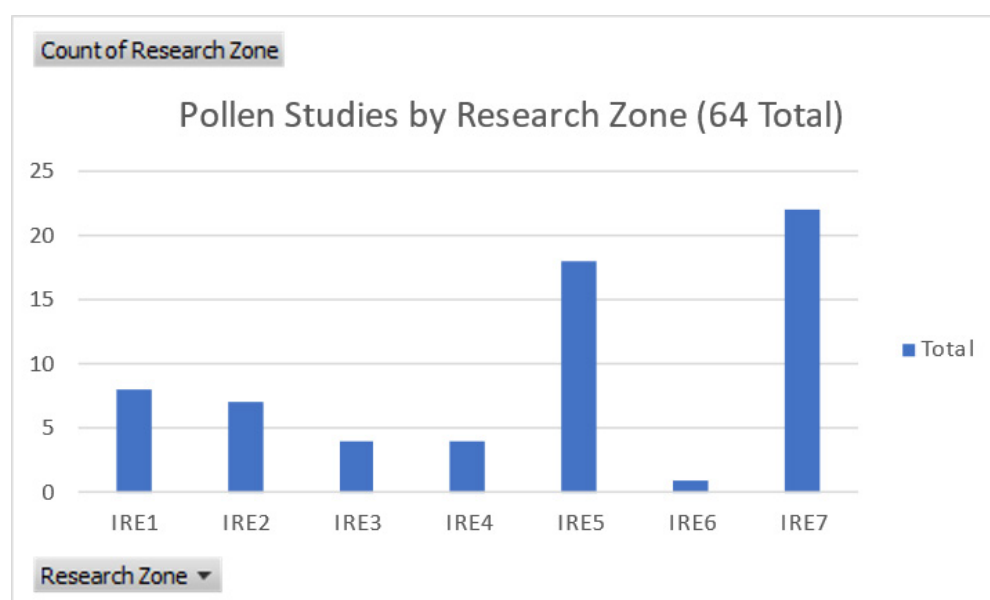


Figure 5. Graph showing the number of reliably dated pollen studies in Ireland by research Zone (IRE1-IRE7).

c. 800–750 BC shift can be interpreted as either a move to increasingly wet, but without specificity as to warmer or cooler temperatures (*pers comm* Gill Plunkett).

These prior findings have been used to present a general Island-wide Bronze Age climate picture that envisions an overall period of increasing wetness from the onset of the Bronze Age until c. 1700 BC, followed by a shift into the MBA marked by dryer/warmer weather and decreases in arboreal pollen (Ballie and Munro 1988; Plunkett *et al.* 2013) that lasted until c. 1300–1250 BC. The dryer/warmer period of the early MBA gave way to a wetter/warmer late MBA, followed by a climactic event seen in the dendrochronology at 1159 BC, at which time the climate shifted to a wetter period marked by a ‘cold peak’ from c. 1150–960 BC (O’Connell 2021). The cold peak ceded to a warming trend with continued wetness until a more defined shift to even wetter conditions was seen c. 800–750 BC (Plunkett *et al.* 2013: 22).

Over 500 pollen studies from Irish palaeoenvironmental monoliths, cores, and soil samples were identified from publications and the Irish Pollen Site Database (IPOL). To assess if the generalized pattern was indeed broadly applicable, or if there were more nuanced – and localized – palaeoenvironmental and palaeoenvironmental shifts, existing studies in each Zone were evaluated. The compiled dataset was filtered based to remove studies: 1) that were outside of the boundaries of research Zones IRE1-IRE7; 2) that had not been subject to peer review; 3) that did not cover the Bronze Age; 4) with layers constrained by radiocarbon dates generated by a peat sample where it could not be confirmed that humic acid was removed, the radiocarbon dates were pre-1980, or the use of the correct half-life in the radiocarbon samples could not be confirmed; and 5) the time periods of the layers were constrained with fewer than three radiocarbon dates. The final sample set resulted in 64 total paleoenvironmental samples across the seven research Zones (Figure 5). The data was used to generate localized palaeoenvironmental and palaeoclimatic reconstructions for comparative analysis.

Paleoenvironmental reconstructions and comparative assessment of regional results against general chronologies

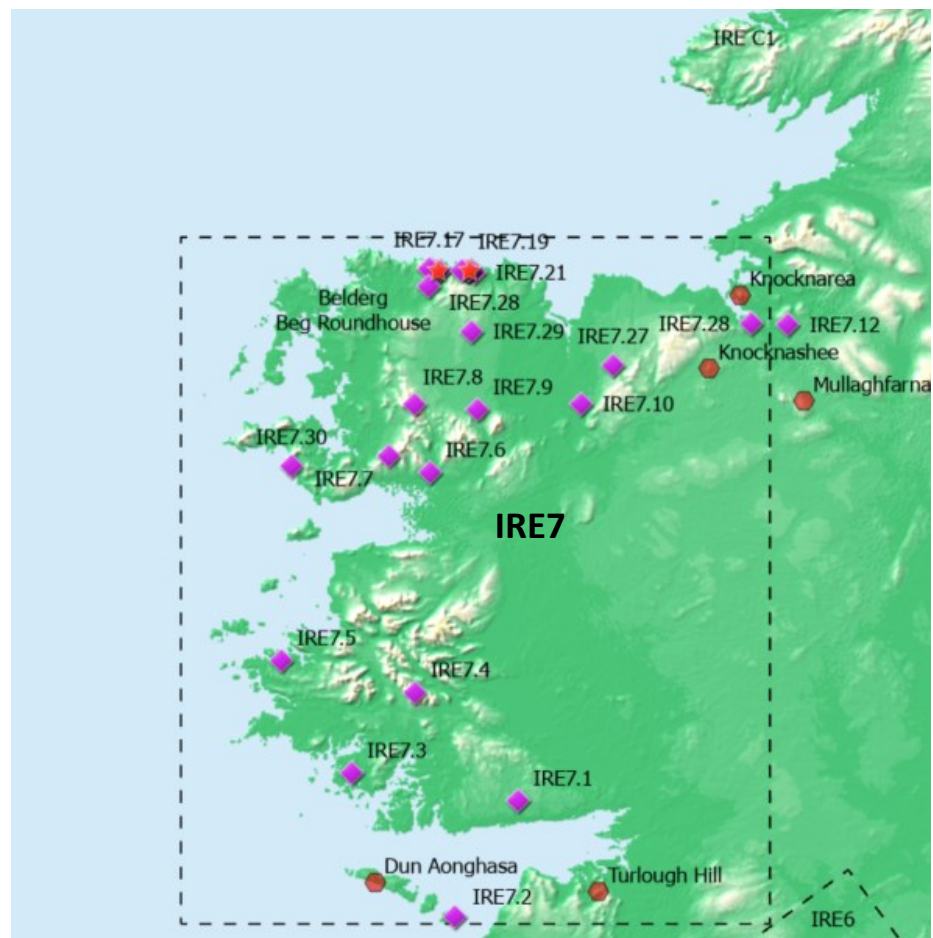
After an initial assessment of the new dataset, the most noticeable concern was around the conclusions based on C-ITs. The stable C-ITs recorded by McKeever and Davis (2013) placed the C-ITs at a steady 14 °C throughout the late Holocene in Zone IRE7 based on cores taken at Cregganmore Lake (4km

south of the Belderrig roundhouse). Taylor *et al.* (2018) identified C-IT shifts in temperature from cores sourced at Lough Meenachrina on the eastern promontory above IRE7 (Glencolmcille, Co. Donegal) with climate shifts observed to have taken place roughly every 300 years (c. 2050 BC, c. 1750 cal BC, c. 1550 BC, c. 1250 BC, c. 1000 BC, c. 750 BC, c. 500 BC). Chironomid data from cores taken at Loch Dargan (Taylor *et al.* 2013: 3215) indicated warmer temperatures c. 2360–730 BC, including warmer and more productive lakes, with temperature peaks identified at c. 1880 BC and c. 970 BC. The Chironomid derived temperature fluctuation analysis shows the inherent unreliability in utilizing Chironomids to develop a palaeoclimatic reconstruction of the environment. It is improbable that temperatures would have remained stable across millennia as seen in the Cregganmore Lake dataset. Temperature shifts like those seen in the Taylor *et al.* (2018) datasets from Lough Meenachrina would be more reasonably expected, however they must also be viewed through a critical and cautious lens regarding their reliability to accurately determine temperature fluctuation over time, particularly considering the unreliable Cregganmore Lake results. Caution must also be taken not to presume accuracy within the C-IT dataset used to generate the more general Ireland wide palaeoclimatic reconstruction that is more broadly accepted (discussed previously).

Most Zones are still undoing a reconciliation of the palaeonological data, however IRE4 and IRE7 are complete and can be used to illustrate the varying localized conditions that individual geographic locations in Ireland would have seen during the Bronze Age. An analysis of the composite regional data provides preliminary conclusions that highlight the local variances from the larger and more generalized conclusions which have been uniformly applied across the Island of Ireland. The localized shifts in vegetation indicate a responsiveness to regional differences in climate, anthropogenic activity, and land use patterns.

IRE4 (Counties Kilkenny and Wexford) has four paleoenvironmental studies that have been published since 1985 with layers reliably dated to the Bronze Age. All four are taken from low-lying riverine, lake, or coastal locations with altitudes between 0–11 m OD (Kearney *et al.* 2022; Maloney 1985; Timpany 2009; Wheeler and Timpany 2011). The IRE4 upland settlement sites are located 32–90 km inland to the north-northwest of the palaeoenvironmental sample sites and are located 124–242 m OD higher in altitude. The extreme differentials in elevation and distance would make it impossible to superimpose nuanced observations about cereals and arboreal cover generated from distant coastal and riverine locations to more inland and high elevation sites. The difference between the paleoenvironmental samples and upland sites, both in altitude and geographic location, eliminates them as a resource to reliably extrapolate an accurate picture of the environment experienced by the upland settlement sites.

What can be observed from IRE4 based on the paleoenvironmental dataset is that the generally observed decline in woodland cover seen at the beginning of the Bronze Age in Ireland is also seen in IRE4. c. 2500–1800 BC a general decrease in hazel (*Corylus*) and oak (*Quercus*) is seen, while small-scale grassland increases (Kearney *et al.* 2022). From c. 1700–1500 BC a short regeneration in hazel is seen, with a corresponding decrease in grasses and an increase in sedge (Kearney *et al.* 2022). This short period of regeneration is at odds with the more generally accepted palaeoenvironmental picture in Ireland at the end of the EBA (Plunkett *et al.* 2013). The MBA in IRE4 appears to be marked by a prolonged period of grassland expansion, particularly ribwort plantain (*Plantago lanceolata*), sorrel (*Rumex*) and daisy (*Asteraceae*) (Kearney *et al.* 2022; Wheeler and Timpany 2011). The increased presence of bracken, sphagnum, alder (*Alnus*) and hazel (*Corylus*) c. 1100 BC is generally agreed across the IRE4 palaeoenvironmental samples and points to an environment that sees increasingly wet conditions (Kearney *et al.* 2022; Wheeler and Timpany 2011), albeit with lower hydrologic flows in the riverine environs. This could imply either degradation of the catchment banks or periods of heavy rain mixed with dry spells where saturated environments held more standing water. There is not, however, any indications to suggest that at any period the riverine environs were subject to inundation or flooding conditions. In this area the LBA sees an increase in the diversity of herbaceous plants alongside greater woodland regeneration. This is followed by a marked increase at c. 820–780 BC where samples taken at New Ross Wetland 2 (Wheeler and Timpany 2011) show a pronounced increase in sphagnum, bracken and fungi. This has been interpreted to indicate a shift to a substantially wetter environment (Wheeler and Timpany 2011); this period is also marked by



Author	Date	GIS Map Label	Location	Lake or Terrestrial
Taylor <i>et al</i>	2018	IRE C1 (Control Point)	Lough Meenachrina	Lake
O'Connell <i>et al</i>	2020	IRE7.13, IRE7.14, IRE7.15, IRE7.16, IRE7.17, IRE7.18, IRE7.19, IRE7.20, IRE7.21, IRE7.22, IRE7.23, IRE7.24, IRE7.25, IRE7.26, IRE7.27, IRE7.28, IRE7.29, IRE7.30	Ceide Fields: BHY VI (IRE7.20), BHY I and IV (IRE7.23, IRE7.24), BHY III (IRE7.22), BHY V (IRE7.25), CF I and III (IRE7.19), VC, GLU IV (IRE7.21) Belderrig : BEL (IRE7.15), BE-S1 (IRE7.13) BHY II (IRE7.26) Dooega (Achill) (IRE7.30), Croaghnaun East (IRE7.29), Carrownaglogh (IRE7.27), Patchico (IRE7.16), Cooney Lough (IRE 7.28)	Terrestrial
Taylor <i>et al</i>	2013	IRE7.12	Lough Dargan (DARG1 and DARG2)	Lake
O'Connell	2021	IRE7.4,	Mam Ean, Nephin Bogs	Lake/Terrestrial
Verrill and Tipping	2010	IRE7.11	Balderrig Beg	Terrestrial
Molloy and O'Connell	2004	IRE7.2	An Loch Mor (1, 2, 3)	Lake
McKeever and Davis	2013	IRE7.26	Cregganmore Lake	Lake
Caulfield <i>et al</i>	2009	IRE7.11	Belderrig Beg	Terrestrial
Bradshaw and Brown	1987	IRE7.8, IRE7.9, IRE7.7, IRE7.6	Lough Kilnabinnia (Loch Corslieve), Lough Clevala, Lough Anaffrin, Lough Navroony (Loch Aisling)	Lake
Coxton and Coxton	1991	IRE7.8, IRE7.9, IRE7.7, IRE7.6	Lough Kilnabinnia, Lough Clevala, Lough Anaffrin, Lough Navroony	Lake
Molloy and O'Connell	1991	IRE7.5	Lough Sheeans	Lake
O'Connell and McDonnell	2019	IRE7.3	Loch an Chorcaill	Lake
O'Connell <i>et al</i>	1988	IRE7.1	Lough Namackanbeg	Lake
Molloy and O'Connell	2004	IRE7.2	An Loch Mor	Lake
Holmes <i>et al</i>	2020	IRE7.2	An Loch Mor	Lake

Figure 6. IRE7 research area with mapped locations of cited pollen studies located in IRE7 and table of pollen studies. Map created using ESRI ArcGIS Pro World Topographic Base Map.

a significant increase in charcoal. In the IRE4 cores, cereal appears c. 2860–2420 BC and while accounted for during c. 2500–1880 BC, it is not well represented (Kearney *et al.* 2022). In the MBA, cereal is more prominently represented from c. 1380–1220 BC and again at c. 1020–915 BC (Kearney *et al.* 2022). The final representation of cereal seen corresponds to a period of woodland regeneration during in the Loch Cullin cores suggesting that – at least in this location – a shift in land use patterns took place (Kearney *et al.* 2022). The palaeoenvironmental samples in the riverine locations show simultaneous expansions in oak (*Quercus*), alder (*Alnus*), hazel (*Corylus*), grasses (*Poaceae*) and sedges (*Cyperaceae*) across the varying periods of the Bronze Age that is correlated with increases in *Gloeotrichia* cyanobacteria, suggesting that the environment was subject to increased phosphates (Wheeler and Timpany 2011). The most logical explanation for this would be an environment experiencing high anthropogenic use, probably in the form of animal husbandry or artificial fertilization of fields. Whether this pattern is repeated in the upland areas of IRE4 cannot be determined based on the lack of upland-based palaeoenvironmental studies.

IRE7 (Counties Galway, Mayo and Sligo) has 15 palaeoenvironmental studies that have been published since 1987 with layers reliably dated to the Bronze Age (Figure 6). Samples taken nearest to the site of the Belderrig roundhouse have age depth models done at BHY III and BHY IV indicating peat formation no later than c. 2750 BC, and formation at BHY V no later than c. 2300 BC (O’Connell *et al.* 2020: 17). At BHY VI peat formed c.2600cal BC, with grassland replacement of arboreal birch (*Betula*) complete by c. 2000 BC (O’Connell *et al.* 2020: 17). BHY V1 had a landscape marked by a lack of arboreal cover and dominated by grassland from c. 1800–120 BC, with cereal pollen well represented from the EBA until the EIA (c. 400 BC) (O’Connell *et al.* 2020: 19). The presence of cereal pollen throughout the Bronze Age and into the Late Iron Age is likewise reflected at BHY V (O’Connell *et al.* 2020: 19). Verrill and Tipping (2010: 123–4) affirmed the presence of cereal pollen by taking new samples from a trench profile associated with Seamus Caulfield’s 1970s excavations at the Belderrig roundhouse. The excavation profile was identified by context, with soil samples being taken from the context above ard marks found embedded into the upper layer of the roundhouse floor; the ard marks were dated to the LBA-EIA c. 770–400cal BC (SUERC-2046/GU-11268, 2450 ± 35) based on infill (Verrill and Tipping 2010: 123–124). A pine flush and increase in bog pine (*Pinus*) takes place between c. 2750–2350 BC at BHY III, BHY IV, BHY V and BHY VI, with a tapering-off of pine occurring within the first two centuries of the EBA (O’Connell *et al.* 2020). At Glenulra, Lough Dargan, and Cooney Lough evidence of more robust anthropogenic land use is evident beginning at c. 2400 BC, with a significant increase through the EBA until a short downturn at c. 1700–1650 BC (O’Connell *et al.* 2020, 23). CF I, CF II, and PLM (located at, and next to, the stone wall nearest the Ceide Fields Visitor Centre) show peat initiation at CF I occurring c. 1000 BC, followed by a treeless grassland attributed to pastoral use; however, no cereal is present until c. 550–390 BC (EIA) (O’Connell *et al.* 2020: 18).

In IRE7 all elevations exhibit a pattern of decrease in yew (*Taxus*) from the start of the Bronze Age through to the Iron Age, however, the continued presence of yew remained more pronounced at Loch Kilnabinnia than in Mám Eán (Bradshaw and Brown 1987; Brown and Coxton 1981; O’Connell 2021). This may be owing to the larger faunal role yew played in the Loch Kilnabinnia environs prior to the Bronze Age (O’Connell 2021). Lough Annafrin showed no measurable presence of yew in the landscape until the late Bronze Age, at which time pollen data indicates the arrival of a measurable presence of Yew which continued to increase through the end of the Bronze Age and into the Iron Age (Bradshaw and Brown 1987; Coxton and Brown 1981; O’Connell 2021). The only other site to exhibit a comparative expansion of yew was the lowland site of Loch Clevala (located at 60 m OD) (Bradshaw and Brown 1987; Coxton and Brown 1981; O’Connell 2021). Pine (*Pinus*), yew (*Taxus*), and elm (*Ulmus*) were all ultimately marked by decline in the Bronze Age; while oak (*Quercus*) and hazel (*Corylus*) maintained a consistent presence across the landscape with nominal changes during the Bronze Age; none correspond directly with settlement radiocarbon dates.

In IRE7 ribwort plantain (*Plantago*) sees a general increase in all pollen cores beginning with the Bronze Age, however the overall statistical increase appears to be driven by significant and disproportionate increases at Loch Kilnabinnia (Molloy and O’Connell 1991; McKeever and Davis 2013; O’Connell and McDonnell 2019; O’Connell 2021; Taylor *et al.* 2013; Taylor *et al.* 2018; Verrill and Tipping 2010). Loch

Kilnabinnia provides evidence of the largest increase of *Ericoid* species represented in pollen cores across IRE7 during the Bronze Age (Bradshaw and Brown 1987; Coxton and Brown 1981; O'Connell 2021).

IRE7 also contains offshore island environs. For the purposes of this project the offshore palaeoenvironmental data was considered separately against the onshore data. This was with the intent of understanding if an offshore island environment topographically marked by high cliffs that would possibly have been more vulnerable to wind and salt sprays experienced a micro-climate visible in the palaeobotanical record. In geographic terms, the single pollen study conducted nearest to the settlement site of Dún Aonghasa (an enclosed upland promontory fort on the Island of Inis Mór) comes from An Loch Mór on the island of Inis Oírr. Inish Oírr is located at the easternmost end of the chain of the Arran Islands, with An Loch Mór on the northeastern side of the island in a low-lying location. Pollen samples taken from lake sedimentary core in 1997 at the deepest part of the lake were analysed in segments over many years, with the Bronze Age segment being investigated and published by Molloy and O'Connell (2007). The An Loch Mór palaeoenvironmental cores are the only ones taken from the Arran Islands, and while there is no dated evidence for occupation at Dún Aonghasa before c. 1500 cal BC and no dated settlements adjacent to the An Loch Mór coring site, the pollen profiles indicate a sustained human presence and use of the landscape for farming beginning in the EBA, with grassland cover and barley pollen present from the EBA through to the LBA-EIA (Molloy and O'Connell 2007: 10–12). Within the Arran Islands pine and elm saw a decrease, with hazel increasing, starting at c. 1750 BC (Molloy and O'Connell 2007: 10–12). During the LBA c. 1050 BC, pine, oak, and hazel continue to decrease while ash and grasslands indicators increase (Molloy and O'Connell 2007: 10–12).

Cotter *et al.* (2012 Vol 2: 205) presumes that prehistoric climatic conditions on the island of Inis Mór would have been much as they are today with respect to wind; however, during the Bronze Age, oak did not reflect exposure to volatile conditions or effects of salt spray, as the growth rings from heartwood charcoal samples indicates average year to year growth. Two samples of hazel (Sample 23 and Sample 6) indicated exposure to more challenging growing conditions, with growth rings suggesting periods of both slow and fast growth, perhaps owing to varying conditions or differing locations on Inis Mór (Cotter *et al.* 2012 Vol 2: 205). Despite the likelihood of exposure to wind and salt overspray because of the island location, the exposed position in the Atlantic, and narrow width of the island, the high variability in species found in charcoal indicates it was well-wooded with a wide variety of trees (Cotter *et al.* 2012 Vol 2: 205). This would suggest that Inis Mór would have been far less 'marginal' than it appears today, as a depth of soil no longer present on the currently denuded island would have been required to support both the broad arboreal cover and the cultivation of cereal grains. The presence of holly, yew, birch and hazel further suggests that the island had areas of soil that were more acidic and wet, and likely saw more rainfall; both of which would have created growing conditions more suitable for those species. The notable absence of elm could suggest that the soil lacked a certain degree of fertility but may also reflect the broader decline of elm across Ireland during the latter period of the Bronze Age.

Charcoal was collected and analysed during the excavation of Dún Aonghasa and was used as a basis for partial palaeoenvironmental reconstruction of the localized environs on Inis Mór (Cotter *et al.* 2012 Vol 2:106–107). The consistently high presence of pine within the charcoal record across Dún Aonghasa from the MBA to the end of the Bronze Age (and into the EIA to a lesser extent) is at odds with the pollen records produced from the broader onshore environs across Zone IRE7, which indicate a decrease in pine from c. 1260–1100 BC and a pine regeneration from c. 920–620 BC (discussed above). While onshore pine sees a decrease into the later part of the Bronze Age and into the EIA, offshore at Dún Aonghasa pine remains the most frequently burned wood source following: 1) oak (across all periods); 2) oak, hazel, and juniper during the MBA; and 3) oak and blackthorn during the LBA (Cotter *et al.* 2012 Vol 2: 106–7). In more localized terms, the quantities of charcoal by species found during the 1993–1995 excavations at Dún Aonghasa are reflective of the pollen makeup found in the An Loch Mór samples, implying that the Arran Islands had their own localized palaeoenvironmental conditions. A general paucity of samples from onshore radiocarbon dated sites in IRE7 do not permit an analysis of the type of wood being used for fuel. This also eliminates the ability to evaluate wood use against larger pollen profile.

Preliminary conclusions of inter and intra-regional palaeoenvironmental and settlement chronology comparative analysis in Ireland

The palaeoenvironmental data seen locally at IRE4 and IRE7 (both onshore and offshore) is generally not in alignment with the wet/dry shifts proposed on the more generalized island-wide environmental chronology for Ireland. The suggested general decrease in arboreal pollen c. 1700–1280 BC can be observed in IRE4 but does not occur until c. 1500 BC, some 200 years after the general proposed date. The offshore environs of IRE7 observe a decrease in specific types of arboreal pollen c. 1750 BC, roughly 50 years before the more generally proposed decrease, while the onshore environs of IRE7 saw a general decrease in pine, yew, and elm across the larger *durée* of the Bronze Age but had fairly a stable oak and hazel arboreal profile. IRE4 indicates a general decrease oak from the EBA, with a resurgence c. 1000 BC that corresponds with a larger increase in woodland cover until in the EIA. IRE7 onshore and IRE7 offshore exhibit different profiles for pine across the Bronze Age, with IRE7 onshore decreasing while the offshore locations indicate a relatively stable arboreal presence. Neither the woodland regeneration in IRE4 during the LBA or the continued presence of pine in the offshore IRE7 environs correlate with either human activity or climactic shifts proposed under the general Irish palaeoenvironmental chronology.

Declining woodland cover evidenced by increases in grassland species pollen has been used as a proxy to indicate anthropogenic activity consistent with farming. The presence of cereal in the EBA and MBA in IRE4 during periods of grassland expansion would appear to support that, however, the appearance of cereal in the LBA during a period of increased arboreal cover that occurs simultaneously with an increase in herbaceous plants would suggest that caution is necessary when presuming that woodland regeneration indicates either a decreased presence or a lack of anthropogenic presence in the landscape. Palaeoenvironmental data from IRE7 (both onshore and offshore) indicating cereal presence during both periods of arboreal increase and grassland decline further supports this observation. For reasons discussed earlier, CI-Ts should be used with an abundance of caution; however, if the datasets are applied to the palaeoenvironmental chronology of Ireland, IRE4 and IRE7 datasets indicate that cereal is present across periods associated with both warming and persistent cooling.

In IRE7 cereal pollen is present more generally across both offshore and onshore palaeoenvironmental samples from c. 2500 BC and into the EIA, with it observed more broadly in the pollen diagrams at c. 1400 BC and c. 700 BC. The reliable settlement chronologies in IRE7 date from c. 1500 BC through c. 250 BC. A comparison reveals that despite a lack of radiocarbon dated settlements from c. 2500–1500 BC cereal is still present in the pollen record. This could be explained as cereal that continued to grow in the environment as part of unintentional cultivation; however, it is more realistically explained as indicating the presence of settlement, or anthropogenic land use associated with either unidentified or undated settlements or cultivation without associated settlements. The possibility that land was being cultivated or used for grazing while settlement was taking place elsewhere should not be eliminated. The paucity of radiocarbon dated settlement in IRE7 complicates an accurate understanding of the relationship between environment, land use, and settlement.

In IRE4 the distance between palaeoenvironmental samples and the upland settlement locations eliminates the use of the palaeoenvironmental samples for any climate impact comparison against the upland IRE4 settlement chronologies. This problem highlights the importance of collecting palaeoenvironmental samples from locations immediately adjacent to archaeological sites to ensure that the environmental samples are being used to generate reconstructions which accurately represent the human-environmental interface from the site surrounds.

Plotting the 22 sites across the Irish research Zones on GIS has produced some preliminary general observations. When visualized on GIS using a slope terrain basemap, settlement sites are seen predominately located on landscapes areas with a 6–10° slope. This is consistent across sites with Bronze Age occupation dates, regardless of their period. In many cases the roundhouses take advantage of narrow spaces in the larger topography that are relatively level; however, most are situated on platforms

that have been artificially constructed to create somewhat level ground for a dwelling. There is also a substantive number of roundhouses – particularly in hilltop locations – where naturally occurring flat plateaus have been utilized as building sites. This should be considered a preliminary observation only, as the sites exhibiting the largest percentage of survival are on hillsides where ploughing has mitigated the degree of destruction they have been subject to.

When the GIS map of the sites have an aquifer base layer (IE GIS Aquifers Ireland (ROI) ITM) and a geologic base layer (IE GIS OneGeology Bedrock and Surface Geology 1M Ireland (ROI) WSG584) applied, there are some additional preliminary observations. There is no apparent correlation between settlement sites and mapped aquifers. Settlement sites are situated on areas of post-glacial Dimictic Till.

More generally, it can be observed that hilltop settlement sites and those exhibiting higher density or no surface visibility before excavation are not found in association with relic field systems. Non-hilltop sites exhibiting high landscape visibility reliably dated to the Bronze Age are commonly found in low density (typically single isolated or widely dispersed) and in association with extensive field walls. Whether or not those field walls are contemporaneous remains an issue for further comparative study, however the link does pose some interesting questions regarding land use, social-spatial organization and the possibility that industrial scale agriculture production was being practiced alongside patterns of agglomerated settlements.

The study focuses on refining settlement chronologies, so it must be mentioned that the overall paucity of reliably radiocarbon dated sites in Ireland makes modelling the occupation chronologies of sites down to generational level effectively impossible. Further complicating our understanding is the fact that occupation dates at the LBA-EIA transition and into the first two centuries of the EIA fall on the Hallstatt Radiocarbon Plateau. The inherent inability to refine the dates which fall on this section of the radiocarbon curve means that we cannot accurately pinpoint the date when settlements saw abandonment within this period. For those that postdate the Hallstatt Plateau we can, however, confidently say that occupation was ongoing post-Bronze Age. In the case of the uplands, the only sites that fall within this category are those situated within hilltop site locations. The preliminary study results indicate that - at present - there is no evidence of events in either the palaeoenvironmental record or in the site archaeologies indicating that any of the settlements were subject to severe weather events which might drive a population to react by shifting their settlement patterns. There is no evidence of inundation or mass destruction/damage as the result of fire or wind. To the contrary, the continuum of occupation seen in the radiocarbon dating into the EIA indicates that Bronze Age people continued to utilize and live in upland environments despite climate ‘shifts’ seen in either oak dendrochronology or tephra markers. The only visible hiatus in upland occupation occurs at c. 2200–1950 BC. Whether this finding is consistent across both upland and non-upland sites is unfortunately beyond the scope of this project.

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**General Session:
Current Research in the Metal Ages**

On ne naît pas femme : on meurt comme telle.

Sex, gender and personhood in the Early Bronze Age

Sabrina N. Autenrieth¹

Abstract

In current discussions about past identities, the concepts of personhood and gender often focus on the binary distinctions of female and male characteristics. This paper approaches the concept of personhood from a different angle, arguing that age may have played a more important role in shaping a person's identity than binary gender distinctions. By comparing Early Bronze Age burial practices within the broader river landscape of the Rhine, this study aims to identify how personhood may have been represented in burial customs during this period.

Methodologically, this research uses Network Analysis to visualize the relationships between biological sex and age of the buried individuals, as well as the grave goods that accompany them. One of the key advantages of using Network Analysis is that it is based on a relational approach as opposed to a purely categorical one. As a result, Network Analysis enables a more comprehensive analysis, rather than solely focusing on the presence or absence of categories.

Key words: Gender Archaeology, personhood, identity, Bronze Age, grave goods, Network Analysis

Résumé

Dans les débats actuels sur les identités passées, les concepts de personne et de genre se concentrent souvent sur les distinctions binaires entre les caractéristiques féminines et masculines. Cet article aborde le concept de personnalité sous un angle différent, en soutenant que l'âge pourrait avoir joué un rôle plus déterminant dans la formation de l'identité d'un individu que les distinctions binaires de genre. En comparant les pratiques funéraires de l'âge du Bronze ancien dans le paysage fluvial élargi du Rhin, cette étude vise à identifier comment l'identité était représentée dans les coutumes funéraires de cette période.

Sur le plan méthodologique, cette recherche utilise l'analyse de réseaux pour visualiser les relations entre le sexe biologique et l'âge des individus inhumés, ainsi qu'avec le mobilier funéraire qui les accompagne. L'un des principaux avantages de l'analyse de réseaux est qu'elle repose sur une approche relationnelle, par opposition à une approche purement catégorielle. Par conséquent, l'analyse de réseaux permet une analyse plus exhaustive, plutôt que de se focaliser uniquement sur la présence ou l'absence de catégories.

Mots-clés: Archéologie du genre, personne, âge du Bronze, mobilier funéraire, analyse de réseaux

Sex, Gender and Personhood in Archaeology

The production and distribution of knowledge (through research, publication, and teaching) has been largely dominated by white, Western, middle-class men (Spector and Whelan 1989: 66).

Gender has become one of the most strongly discussed topics in social sciences and modern media. These discussions often revolve around issues of sexism, inequality, and women's rights. Moreover, the conversation also involves debates around gender expression, sexual orientation, transsexualism, and same-sex marriage. But what is gender, and how does archaeological research portray gender in narratives of the past, specifically the Bronze Age?

In archaeological research on the Bronze Age, both sexes are usually represented in very stereotypical ways. Men are predominantly depicted as warriors, chiefs, shamans, princes, craftsmen, or hunters who actively shaped the society in which they lived in (Meller 2017; Kristiansen and Larsson 2005; Kristiansen 2017). In contrast, women's primary contributions to Bronze Age societies are often depicted as rather passive. Cooking, weaving, childcare, and pottery-making (Kristiansen *et al.* 2017) are usually activities

¹ Independent Scholar; S.N.Autenrieth@outlook.de

represented by women. This distinction between active and passive contributions often results in women being neglected or reduced to mere household features. Archaeologists justify this by claiming that women were underrepresented due to poor preservation of bones and, therefore, invisible in the archaeological record (David-Elbali and Hafner 2010). Similarly, children and older people are often bystanders in narratives about Bronze Age societies. Bronze Age men, on the other hand, are made highly visible in archaeological research, if not even overrepresented.

The rise of metalwork during the Early Bronze Age undoubtedly led to the development of a hierarchical society. However, this does not necessarily mean that this hierarchy was based on a strict distinction between the sexes.

Simone de Beauvoir famously stated that ‘One is not born, but rather becomes a woman’ (2010: 283). When we examine gender and personhood in individuals from the distant past, we, as archaeologists, can only observe that while one is not born a woman, one may die as one. This perspective suggests that we can analyse variations in burial practices, particularly regarding the grave goods associated with individuals. These practices depend not only on biological sex but also on the individual’s stage of life, including their age at death. This will be the focus of this paper.

The fallacy of gendered objects

A majority of our understanding of Bronze Age women and men is based on the idea that particular objects reflect gender roles within a society and that specific objects must have belonged to either women or men. Therefore, many scholars determine an individual’s sex by examining their grave goods and categorise objects as either female or male (Figure 1). Although this way of thinking is based on circular reasoning, this approach remains a common practice in archaeological research (e.g., Kleber 2001: 281; Vandkilde 1996: 136).

(Un-)Doing Gender in Archaeology

As mentioned above, the term ‘gender’ is often associated with women and men in archaeological research. However, gender and sex are two distinct concepts. Simone de Beauvoir (2010: 283), emphasises that gender is a learned and constructed concept and refers to the sociological spectrum. Sex, on the other hand, refers to the bimodal biological spectrum (Butler 1993, 2004; Foucault 1976). This means that a person’s sex is identified at birth through their external sexual characteristics and genes (Iantaffi and Barker 2018). Their gender identity, on the other hand, is constructed by the society they live in (Stig Sørensen 2004). In addition, gender identity is not limited to the binary categories of women and men,

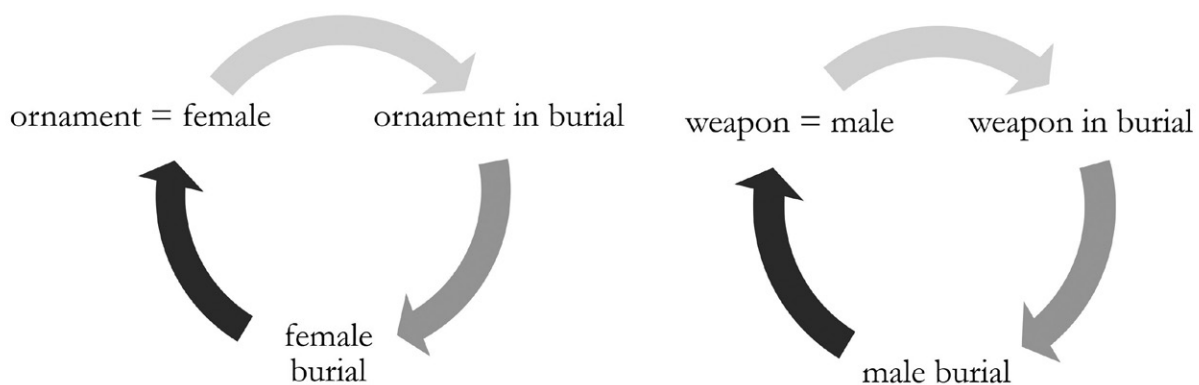


Figure 1. The gendering of objects and identities in archaeological research.

and we must assume that intersex and trans individuals have been a part of past societies, as they are part of our society today. Gender is a fluid concept that varies across cultures and over time, and according to Judith Butler (1990), gender is not inherent and only exists when it is performed.

Furthermore, it is essential to recognise the distinction between sex and gender expression, as noted by Conkey and Gero (1997). Gender expression can be conveyed to others through clothing, accessories, and behaviour. These characteristics of gender expression can be categorised as feminine, masculine, or androgynous, though our current perception of femininity and masculinity may not accurately reflect historical gender expressions.

We have to bear in mind that our present understanding and interpretation of gender do not necessarily reflect the standards of the past. Moreover, it is reasonable to assume that there have always been individuals who did not conform to the prevailing societal norms.

Personhood

In many social systems, personhood is acquired through personal growth (Gregor and Turzin 2001: 11) or rites of passage, meaning the transition from one status in life to another. These transitional moments in a person's life can, for instance, include birth, initiation, marriage, pregnancy, and death (Van Gennep 1909; Turner 1967, 1969). Relationships play a crucial role in the acquisition and maintenance of personhood, which can extend beyond human connections to include places, animals, and objects (Fowler 2004: 7; 2016: 398).

According to Marcel Mauss (1985: 12), there are three distinct aspects of an individual's identity: *moi* (self), *personne* (mask), and *personnage* (role). This means that within a society, people play different roles in various circumstances, which may not necessarily align with their true selves (Morris 1994: 3). These roles can vary greatly depending on the context – for example, someone may behave very differently at work than they do at home or in other social settings. As Radcliffe-Brown (1952: 194) puts it, an individual is a 'complex of social relationships'.

It is not entirely clear how people defined personhood in the past. However, it is widely believed that they distinguished themselves based on various factors such as kinship, skillsets and personal histories (Fowler 2016: 400-401, 408) instead of just physical attributes like age and sex. However, in order to gain insight into this period, analysing the grave goods in combination with the buried individual's biological age can provide a solid foundation to start with, given the limited options available for archaeological research for that time period.

Burials in the river landscape of the Rhine

In the following, I will be examining Late Neolithic to early Middle Bronze Age burials with the aim of testing the above-mentioned assumptions about gendered objects. I will focus on analysing whether there is a difference in the types of grave goods found in burials with female and male skeletal remains within the broader river landscape of the Rhine (Figure 2), including the multi-period cemetery of Singen am Hohentwiel (Krause 1988b), located in Southern Germany. This cemetery encompasses burials spanning from the Late Neolithic to the Late Bronze Age, but for the purpose of this analysis, we will only consider the Early Bronze Age burials that contain metalwork objects. The dataset from Singen is based on the work of Krause (1988b) and the anthropological analysis by Gerhardt (1964) while the rest of the data is sourced from the catalogues by Abels 1972, Gebers 1978, Krause 1988a, Hafner 1995, Herring 2009, and Schaer *et al.* 2019.

It is essential to mention that this particular dataset consists of various burial types, burials from different time periods of the Early Bronze Age, and burials that contain metalwork, since metal has a better preservation in different soils than organic material. This means that burials void of grave goods or metalwork objects were not included in this analysis.

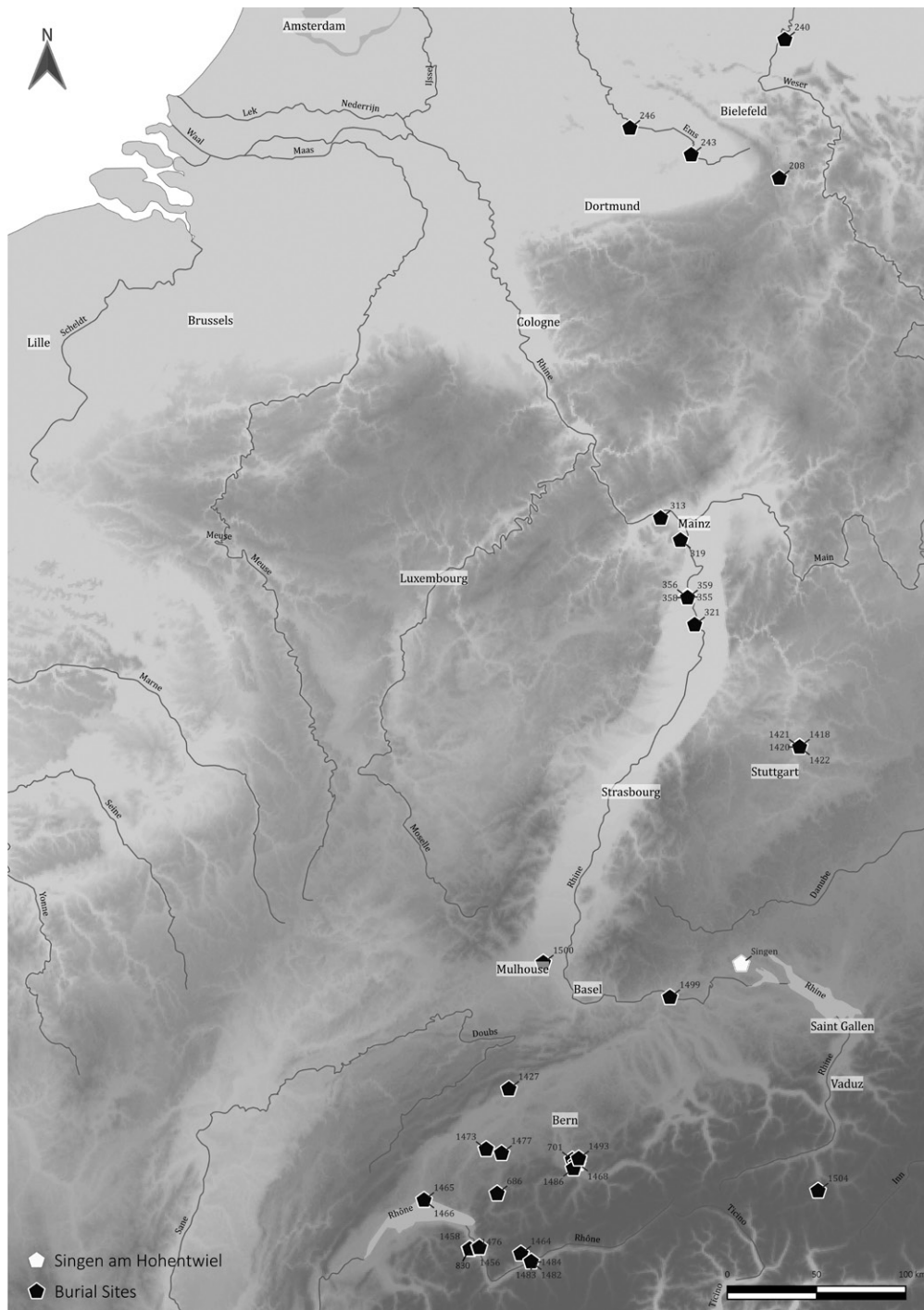


Figure 2. Burial sites creating the basis of this data analysis (DEM Source: Copernicus Land Monitoring Service; Populated cities, rivers, and lakes: Natural Earth Data; Sites of burials: see Figure 3).

Figure 3 shows the anthropologically defined burials within the river landscape of the Rhine, including the multi-period cemetery of Singen am Hohentwiel. It is worth noting that the burials of Ecublens (1465 and 1466) cannot be included in the analysis, since these burials contain one male and one female individual respectively, and it is unclear which object categories belong to which individual.

Figure 3. LN-MBA burials with information on sex and/or age of buried individuals from the broader river landscape of the Rhine.

Id	Site	Country	State	Catalogue	Reference	Period	Sex	Age Group
1	Singen am Hohentwiel (55/25)	Germany	BW	Krause 1988b	298, 6	EBA	unknown	<i>infans I/II</i>
2	Singen am Hohentwiel (55/24)	Germany	BW	Krause 1988b	298, 7	EBA	possibly female	<i>early adultus</i>
5	Singen am Hohentwiel (55/19)	Germany	BW	Krause 1988b	300, 11	EBA	unknown	<i>infans II</i>
6	Singen am Hohentwiel (55/18)	Germany	BW	Krause 1988b	301, 12	EBA	unknown	<i>infans II</i>
8	Singen am Hohentwiel (55/12)	Germany	BW	Krause 1988b	303, 18	EBA	possibly male	<i>adultus</i>
9	Singen am Hohentwiel (55/13)	Germany	BW	Krause 1988b	304, 19	EBA	unknown	<i>infans I/II</i>
14	Singen am Hohentwiel (55/8)	Germany	BW	Krause 1988b	308, 29	EBA	possibly female	<i>maturus</i>
22	Singen am Hohentwiel (51/17)	Germany	BW	Krause 1988b	313, 43	EBA	unknown	<i>infans I & juvenis</i>
23	Singen am Hohentwiel (51/6)	Germany	BW	Krause 1988b	314, 46	EBA	unknown	<i>infans I</i>
25	Singen am Hohentwiel (53/18)	Germany	BW	Krause 1988b	318, 57	EBA	female	<i>maturus</i>
31	Singen am Hohentwiel (58/1)	Germany	BW	Krause 1988b	322, 64	EBA	unknown	<i>adultus</i>
32	Singen am Hohentwiel (52/5)	Germany	BW	Krause 1988b	322, 63	EBA	male	<i>middle adultus</i>
33	Singen am Hohentwiel (53/04)	Germany	BW	Krause 1988b	323, 65	EBA	female	<i>senilis</i>
34	Singen am Hohentwiel (52/24)	Germany	BW	Krause 1988b	323, 66	EBA	possibly male	<i>infans I/II</i>
35	Singen am Hohentwiel (52/22)	Germany	BW	Krause 1988b	324, 67	EBA	male	<i>maturus-senilis</i>
36	Singen am Hohentwiel (52/19)	Germany	BW	Krause 1988b	325, 68	EBA	male	<i>middle-maturus</i>
37	Singen am Hohentwiel (52/17)	Germany	BW	Krause 1988b	325, 69	EBA	possibly male	<i>adultus</i>
38	Singen am Hohentwiel (52/14)	Germany	BW	Krause 1988b	326, 70	EBA	male	<i>maturus-senilis</i>
39	Singen am Hohentwiel (52/3)	Germany	BW	Krause 1988b	328, 73	EBA	male	<i>adultus</i>
40	Singen am Hohentwiel (52/6)	Germany	BW	Krause 1988b	329, 74	EBA	female	<i>early adultus</i>
41	Singen am Hohentwiel (52/10)	Germany	BW	Krause 1988b	329, 75	EBA	unknown	<i>adultus</i>
42	Singen am Hohentwiel (51/7)	Germany	BW	Krause 1988b	330, 76	EBA	male	<i>maturus-senilis</i>
43	Singen am Hohentwiel (50/19)	Germany	BW	Krause 1988b	330, 77	EBA	unknown	<i>adultus</i>
45	Singen am Hohentwiel (50/15)	Germany	BW	Krause 1988b	332, 79	EBA	male	<i>maturus-senilis</i>
46	Singen am Hohentwiel (50/16)	Germany	BW	Krause 1988b	333, 80	EBA	female	<i>adultus</i>
47	Singen am Hohentwiel (50/17)	Germany	BW	Krause 1988b	335, 83	EBA	unknown	<i>child</i>
50	Singen am Hohentwiel (50/20)	Germany	BW	Krause 1988b	337, 86	EBA	unknown	<i>child</i>

Id	Site	Country	State	Catalogue	Reference	Period	Sex	Age Group
64	Singen am Hohentwiel (50/21)	Germany	BW	Krause 1988b	334, 82	EBA	possibly female	<i>infans I/II</i>
1418	Remseck-Aldingen (Grab 15)	Germany	BW	Krause 1987	159	Bz A1	male	<i>adultus</i>
1499	Küssaberg (Kadelburg-Kiesgrube Tröndle, Grab 2)	Germany	BW	Hafner 1995	213, 61	EBA	male	<i>early adultus</i>
1420	Remseck-Aldingen (Grab 13)	Germany	BW	Krause 1988a	159	Bz A1	female	<i>child</i>
1422	Remseck-Aldingen (Grab 25)	Germany	BW	Krause 1988a	159	Bz A1	female	<i>adultus</i>
1421	Remseck-Aldingen (Grab 14)	Germany	BW	Krause 1988a	159	Bz A1	unknown	<i>child</i>
240	Petershagen-Döhren; Befund 1	Germany	NW	Herring 2009	470, 119.1	EBA/MBA	possibly female	<i>late-maturus</i>
246	Telgte-Raestrup (Dovenacker); Befund 6	Germany	NW	Herring 2009	514, 156.6	EBA/MBA	possibly female	<i>middle adultus</i>
243	Rheda-Wiedenbrück, Nordrheida-Ems; Befund 1	Germany	NW	Herring 2009	482, 128.1	EBA/MBA	male	<i>middle-maturus</i>
208	Bad-Driburg-Pömsben (Schlippenberg); Individual 3	Germany	NW	Herring 2009	383, 9	EBA/MBA	possibly female	<i>unknown</i>
321	Ludwigshafen-Mundenheim (Krügerstraße; Grab 7)	Germany	RP	Gebers 1978	49, 83	LN/EBA	possibly female	<i>maturus</i>
355	Worms (Adlerberg; Grab 6)	Germany	RP	Gebers 1978	102, 165e	LN/EBA	possibly female	<i>adultus</i>
359	Worms (Adlerberg; Grab 21)	Germany	RP	Gebers 1978	103, 165	LN/EBA	male	<i>senilis</i>
313	Heidesheim ('Uhlerborn')	Germany	RP	Gebers 1978	40, 58a	LN/EBA	female	<i>adultus</i>
319	Lörzweiler	Germany	RP	Gebers 1978	47, 79	LN/EBA	unknown	<i>adultus</i>
356	Worms (Adlerberg; Grab 7)	Germany	RP	Gebers 1978	102, 165e	LN/EBA	unknown	<i>maturus</i>
358	Worms (Adlerberg; Grab 14)	Germany	RP	Gebers 1978	103, 165e	LN/EBA	unknown	<i>child</i>
1500	Mulhouse-Est (Riedisheim)	France	HR	Hafner 1995	214, 63	EBA	female	<i>unknown</i>
1486	Spiez-Einigen (Holleeweg, Grab 2)	Switzerland	Kt. B	Hafner 1995	208, 37	EBA	male and male	<i>infans II & maturus</i>
701	Thun (Renzenbühl)	Switzerland	Kt. B	Abels 1972	21, 178	EBA	male	<i>unknown</i>
1427	Prêles (Les Combottes)	Switzerland	Kt. B	Schaer et al. 2019	57-69	Bz B2	male	<i>adultus</i>
1468	Hilterfingen (Im Aebnit/Tannenbühlstrasse)	Switzerland	Kt. B	Hafner 1995	204, 17	EBA/MBA	male	<i>senilis</i>
1485	Spiez-Einigen (Holleeweg, Grab 1)	Switzerland	Kt. B	Hafner 1995	208, 37	EBA	male	<i>infans II</i>
1469	Hilterfingen (Schlosspark Hünegg)	Switzerland	Kt. B	Hafner 1995	204, 18	EBA	female	<i>early adultus</i>
1493	Thun Wiler (Grab 1)	Switzerland	Kt. B	Hafner 1995	209, 43	EBA	unknown	<i>adultus & child</i>
686	Enney (Le Bugnon)	Switzerland	Kt. F	Abels 1972	18, 164	EBA	male	<i>unknown</i>
1477	Posieux (Bois de Châtillon, Grab 10)	Switzerland	Kt. F	Hafner 1995	206, 26	EBA	male	<i>maturus-senilis</i>
1473	Montagny-les-Monts (Au Grabou)	Switzerland	Kt. F	Hafner 1995	205, 23	EBA	unknown	<i>child</i>
1504	Donath (Surses)	Switzerland	Kt. G	Hafner 1995	213, 56	EBA	unknown	<i>adultus & adultus</i>
1475	Ollon-Saint-Triphon (Carrière du Lessus, Grab 1/1979)	Switzerland	Kt. V	Hafner 1995	205, 25	EBA	unknown	<i>early adultus</i>
1476	Ollon-Saint-Triphon (Carrière du Lessus, Grab 2/1979)	Switzerland	Kt. V	Hafner 1995	205, 25	EBA	male	<i>adultus</i>
1465	Ecublens (En Vallaire, Grab 1)	Switzerland	Kt. V	Hafner 1995	203, 14	EBA	female and male	<i>early adultus & adultus</i>
1466	Ecublens (En Vallaire, Grab 2)	Switzerland	Kt. V	Hafner 1995	203, 14	EBA	female and male	<i>early adultus & adultus</i>
1474	Ollon-Saint-Triphon (Carrière du Lessus, Grab C1/1964)	Switzerland	Kt. V	Hafner 1995	205, 25	EBA	female	<i>early adultus</i>

Id	Site	Country	State	Catalogue	Reference	Period	Sex	Age Group
830	Collombey-Muraz (La Barmaz I, Gr. 1)	Switzerland	Kt. W	Abels 1972	48, 336	Bz A2	male	<i>maturus</i>
1458	Collombey-Muraz (La Barmaz, Grab 42)	Switzerland	Kt. W	Hafner 1995	203, 11	EBA	male	<i>adultus-maturus</i>
1482	Sion (Petit Chasseur I, Grab 1)	Switzerland	Kt. W	Hafner 1995	207, 35	EBA	male	<i>unknown</i>
1484	Sion (Petit Chasseur I, Grab 3)	Switzerland	Kt. W	Hafner 1995	207, 35	EBA	male	<i>juvenis</i>
1456	Collombey-Muraz (La Barmaz I, Grab 3)	Switzerland	Kt. W	Hafner 1995	203, 11	EBA	female	<i>adultus</i>
1457	Collombey-Muraz (La Barmaz, Grab 6)	Switzerland	Kt. W	Hafner 1995	203, 11	EBA	female	<i>adultus</i>
1464	Contthey	Switzerland	Kt. W	Hafner 1995	203, 13	EBA	female	<i>early adultus</i>
1483	Sion (Petit Chasseur I, Grab 2)	Switzerland	Kt. W	Hafner 1995	207, 35	EBA	female	<i>adultus-maturus</i>

A Note on the data

I want to emphasize that I am testing assumptions that are relevant to my research region and time period. In different time frames or regions, archaeological research may make other assumptions about gendered objects (e.g., Hachmann 1957; Spector 1993).

Please also note that the analysis presented here is based solely on burials that contained metalwork and disregards all other burials, including those without any grave goods. The absence of grave goods could potentially be an intriguing factor to explore when investigating variations in burial customs. Additionally, it would be worth comparing socio-economic and ritual aspects of burial practices, but this would require a much larger dataset and is beyond the research agenda of this paper.

It is worth highlighting that the osteological analysis for the examined burials was conducted many years ago, which means that the data might be outdated. To ensure accuracy, it would be beneficial to re-examine the dataset with modern methods such as proteomic and genomic sexing (Buonasera *et al.* 2020). Additionally, it would be helpful to include other burial practices such as the placement of the body and objects in the grave, orientation of the head, and treatment of the body (Haughton 2023). Further, it is possible that objects were removed from the burials, as suggested by Sprenger in 1999.

Despite the outdated data and all the potential reasons for the presence or absence of particular objects in the burials of male and female individuals, this analysis will examine whether there is a sufficient basis for assigning gender or personhood to specific objects in burial practices, as previous scholars have mostly done so without looking at any anthropological evidence.

Methodology

The following analysis will involve examining the relationships among buried individuals and their grave goods using Network Analysis. Network Theory is an effective research tool for comprehending complex systems, such as burial traditions. This method is superior to the traditional approach of merely analysing the presence or absence of objects, as it provides a deeper understanding of the data. According to Brandes *et al.* (2013: 4), Network Theory is based ‘[...] on the assumption that a cause, an effect, or an association between aspects involve something that can be conceptualised as a network’. The field of Network Theory is built on the premise that relationships between non-human and human units, such as objects and people, exist and that those relationships are significant (Knappett 2011; Brughmans 2012).

There are two primary data categories in Network Analysis: nodes, which examine the entities, and links, which represent relationships between nodes (Brandes *et al.* 2013). In a network, every node has at least

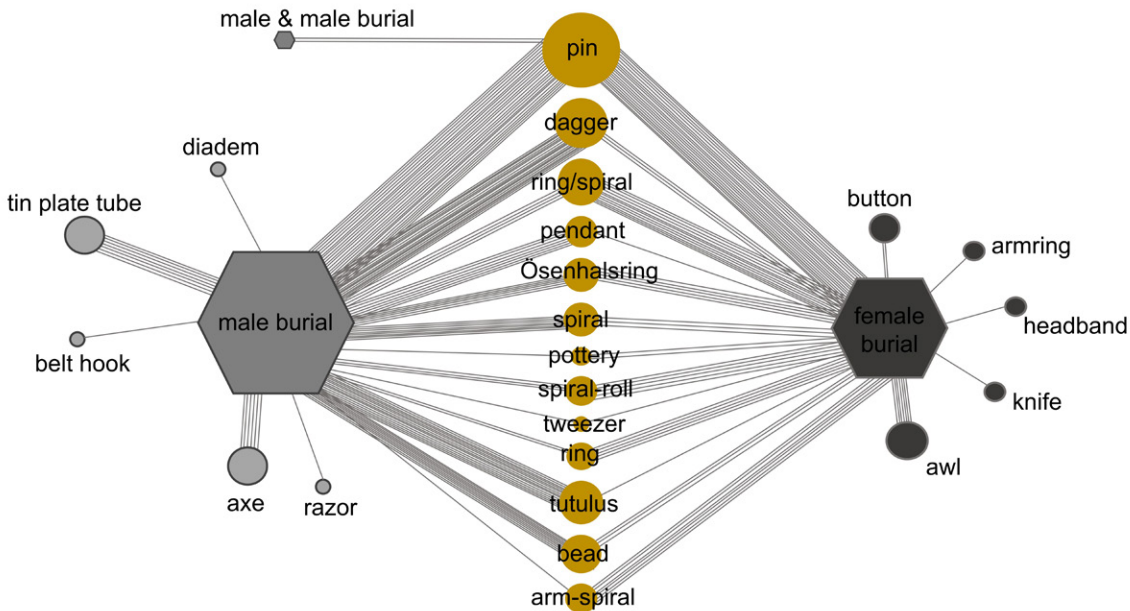


Figure 4. Network Analysis of female and male burials in the broader river Rhine region. $n = 48$; $n_{female} = 22$, $n_{male} = 25$; $n_{male\&male} = 1$; size of nodes represents degree% of node centrality (based on data from Figure 3).

one link. The degree of a node is the total number of links going in or coming out of it. A higher number of links results in a higher degree, called degree centrality (Knappett 2011; Newman 2010).

I will analyse the data in two different ways. First, I will examine the grave goods that were buried with individuals who were anthropologically defined as either female or male as a starting point for analysing burial customs based on factual evidence. Therefore, anthropological data will be utilised to test assumptions about *gendered objects* in burial contexts.

Secondly, I will analyse the grave goods that were buried with each individual age class (after Barta and Štolc 2007: 468): *Infans I* (0-7 years); *infans II* (7-14 years); *juvenis* (14-20 years); *adultus* (20-40 years); *maturus* (40-60 years) and *senilis* (over 60 years). It is worth noting that particularly young adults are relatively simple to classify. Older individuals, on the other hand, are more challenging to differentiate since the living conditions, such as diet and climate, can significantly affect the process of maturation (Brothwell 1981: 64).

Data Analysis

Biological sex

As discussed earlier, objects are typically categorised as either female or male. Ornaments, such as pins and arm-rings, are associated with women, while weapons such as daggers and axes² are believed to be male objects (Feickert *et al.* 2018; Kimmig 1958; Vandkilde 1996; Verlaeck 1996). If this association is accurate, we would expect to find pins or other adorning items in female graves and daggers or axes in male graves. In the following, we will examine whether these associations can be supported by analysing grave goods buried with female and male individuals.

² Daggers and axes are often considered weapons in archaeological research (David-Elbali and Hafner 2010: 223; Kubach-Richter 1994: 56). However, I would argue that while both objects could potentially act as weapons, they were more likely to be used as tools in daily life.

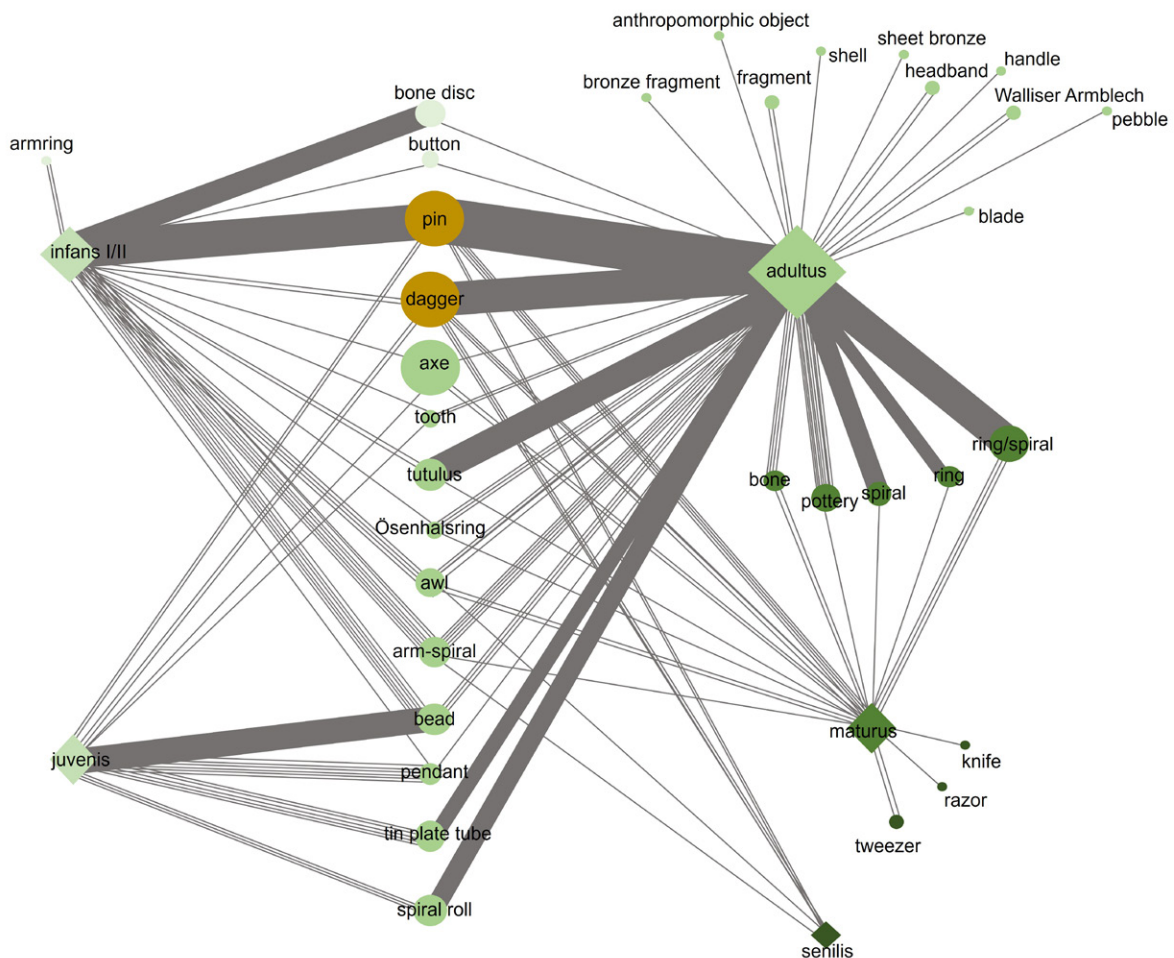


Figure 5. Network Analysis of object categories buried by age classes in the broader river Rhine region. $n_{infans\ I/II} = 16$; $n_{juvenis} = 1$; $n_{adultus} = 28$; $n_{maturus} = 12$; $n_{senilis} = 3$; size of nodes represents degree% of node centrality (based on data from Figure 3).

The Network Analysis (Figure 4) shows which object categories were found in the graves of female and male individuals. The nodes' size represents the degree, and each link represents a direct connection. The common objects shared by both men and women are pins, daggers, pendants, Ösenhalsringe, pottery, tweezers, spirals, spiral rolls, arm-spirals, ring/spirals, tutuli and beads, which are indicated in yellow. Male-specific objects are tin plate tubes, axes, razors, diadem and belt hook. On the other hand, female graves contain objects such as awls, knife, arm-ring, button, and headband.

It is interesting to note that awls that are often considered to be 'male objects' (Kleber 2001; Kubach 1978–1979) only appear in female graves.

The result of this Network Analysis shows one major problem of archaeological analysis, categorisation. Should arm-spirals and arm-rings be classified as one object category? Do buttons and belt hooks count as grave goods, or are they simply part of the dress? These are questions that should be viewed critically, and for the purpose of this analysis, I made a distinction between specific objects and included every object in the analysis that was mentioned in the catalogues and publications that I used for my data collection.

After analysing the data, it becomes apparent that distinguishing between distinct object categories that are exclusively for males or females is challenging. Some object categories are associated with female individuals, such as awls, while others are only associated with males, such as axes and tin plate tubes.

Evidently, most object categories are shared between both sexes, with the pin as the most commonly shared one.³

Biological age

Next, we will compare the burial goods that were given to specific age classes to visualise the distinction in object categories given to each age class and examine whether burial goods in connection with age could be a representation of personhood.

In the Network Analysis of the age classes (Figure 5), it can be observed that each age class, except *juvenis* and *senilis*, have age-specific object categories. For *infans I/II*, these include arm-rings; for *adultus*, handles, blades, sheet bronze, pebbles, shells, bronze fragments, headbands, Walliser Armblech, and anthropomorphic objects; and for *maturus*, knives, razors, and tweezers. Adults were buried with a wide variety of objects, including adornments (pendants, rings, spirals, etc.) and practical items such as daggers, awls, and pottery. However, older individuals (*maturus-senilis* and *senilis*) were only buried with very limited object categories, including daggers, rings/spirals, pins, awls, and arm-spirals. Objects that are only shared between two age classes are bone discs and buttons between *infans I/II* and *adultus*; tin plate tubes and spiral rolls between *juvenis* and *adultus*; rings, rings/spirals, bones and pottery between *adultus* and *maturus*.

Two object categories are consistently buried with all age groups: daggers and pins. Interestingly, daggers and pins were also shared burial goods among female and male individuals. Potentially, this could mean that daggers and pins were a commonly shared, universal, so to speak, mortuary repertoire in the Early Bronze Age of the river landscape of the Rhine. As a result, this observation ultimately contradicts previous research, which assumed that daggers are associated with male warriorhood and that pins were mainly part of women's dress. Based on this information, it can be argued that neither daggers nor pins are exclusive to a particular gender or social and economic status. One could even say that daggers and pins are gender-neutral and the most ordinary thing to be buried with.

If we look at the burials of younger individuals, ranging from infants to adults, we notice that they seem to not have followed a specific set of guidelines and instead allowed for more flexibility within the objects that were given to the deceased. This could mean that burials for younger individuals may have followed the principle of 'anything goes' within the mortuary repertoire.

Notably, older individuals (*senilis*) appear to receive the very common dagger and pin set, which is shared among all age classes and both sexes, as well as awls and arm-spirals. Assuming that objects potentially represent identity or personhood, could this imply that those older individuals were stripped of their personhood? Or is it possible that their personhood is established and ingrained in the person, meaning that they don't need representations of their personhood in death? Alternatively, the personal belongings of older individuals may have been deposited in the surrounding landscape without a human body, recycled to create new objects, or passed down to their heirs before or after their passing.

Heirlooms or memento quod potuit esse?

When examining the objects buried with young individuals, one interesting point to examine is their size in comparison to those associated with older individuals. If the items buried with young individuals are smaller, it suggests that these objects were likely part of their *mundane* or *mortuary* attire. Conversely, if

³ There might be a sex-specific distinction between different types of pins. However, this dataset is too small to make any statements about sex-specific pin-types. Pin-types that were definitely present in burials of both sexes are oar-shaped, wheel-headed and roll-headed pins.

Figure 6. Measurements and positioning of objects buried with young individuals (*infans I/II* – *juvenis*).

Id	Site	Age	Sex	Category	Length	Diameter	Weight	Position
1	Singen am Hohentwiel (55/25)	<i>infans I/II</i>	unknown	arm-spiral		4.0		on arm
6	Singen am Hohentwiel (55/18)	<i>infans II</i>	unknown	arm-spiral		5.5		right arm
9	Singen am Hohentwiel (55/13)	<i>infans II</i>	unknown	arm-spiral		5.6	15.0	right arm
23	Singen am Hohentwiel (51/6)	<i>infans I</i>	unknown	arm-spiral		3.2		
47	Singen am Hohentwiel (50/17)	<i>child</i>	unknown	arm-spiral		6.5	219.0	on arm
64	Singen am Hohentwiel (50/21)	<i>infans I/II</i>	possibly female	arm-spiral		4.2	12.0	on arm
9	Singen am Hohentwiel (55/13)	<i>infans II</i>	unknown	awl	2.2			in front of the face
47	Singen am Hohentwiel (50/17)	<i>child</i>	unknown	awl	3.9			next/close to the skull
50	Singen am Hohentwiel (50/20)	<i>child</i>	unknown	awl	3.1			
64	Singen am Hohentwiel (50/21)	<i>infans I/II</i>	possibly female	awl	4.3			in front of the face
1	Singen am Hohentwiel (55/25)	<i>infans I/II</i>	unknown	bead	1.2	1.1		next to shoulder
1	Singen am Hohentwiel (55/25)	<i>infans I/II</i>	unknown	bead	1.2	1.1		next to shoulder
1	Singen am Hohentwiel (55/25)	<i>infans I/II</i>	unknown	bead	1.2	1.1		next to shoulder
1	Singen am Hohentwiel (55/25)	<i>infans I/II</i>	unknown	bead	1.5	1.1		next to shoulder
64	Singen am Hohentwiel (50/21)	<i>infans I/II</i>	possibly female	bead	1.7			
64	Singen am Hohentwiel (50/21)	<i>infans I/II</i>	possibly female	bead		0.4		at neck
6	Singen am Hohentwiel (55/18)	<i>infans II</i>	unknown	bone disc		1.9		on/in front of the chest
6	Singen am Hohentwiel (55/18)	<i>infans II</i>	unknown	bone disc		3.0		on/in front of the chest
9	Singen am Hohentwiel (55/13)	<i>infans II</i>	unknown	bone disc		2.6		at spine
64	Singen am Hohentwiel (50/21)	<i>infans I/II</i>	possibly female	bone disc		1.9		at neck
5	Singen am Hohentwiel (55/19)	<i>infans I/II</i>	unknown	dagger	7.3		15.0	between both upper arms
47	Singen am Hohentwiel (50/17)	<i>child</i>	unknown	Ösenhalsring		14.2		next/close to the skull
1	Singen am Hohentwiel (55/25)	<i>infans I/II</i>	unknown	pin	7.0		3.0	next to shoulder
6	Singen am Hohentwiel (55/18)	<i>infans II</i>	unknown	pin	11.8		10.0	on/in front of the chest
9	Singen am Hohentwiel (55/13)	<i>infans II</i>	unknown	pin	13.7		13.0	diagonally to the body (at the chest), pointing away from the body
34	Singen am Hohentwiel (52/24)	<i>infans I/II</i>	possibly male	pin	8.6			

Id	Site	Age	Sex	Category	Length	Diameter	Weight	Position
47	Singen am Hohentwiel (50/17)	<i>child</i>	unknown	pin	11.4		9.5	at hands
65	Singen am Hohentwiel (50/21)	<i>infans I/II</i>	possibly female	tooth				at neck
358	Worms (Adlerberg; Grab 14)	<i>child</i>	unknown	armring		3.8		
1484	Sion (Petit Chasseur I, Grab 3)	<i>juvenis</i>	male	dagger	20.2			

the items are the same size as those buried with older individuals, they may represent heirlooms or a potential, yet unrealized, sense of personhood. To investigate this hypothesis, the sizes of objects buried with young individuals (*infans I/II* - *juvenis*) can be compared to those buried with older individuals (*adultus* - *senilis*).

Additionally, the placement of objects in relation to the buried individual's body will be considered; any differences in the positioning of the same object categories in the burials of younger and older individuals could speculatively indicate a development in personhood.

Interestingly, three out of the four awls were placed in front of the faces of young individuals (Figure 6). This placement might signify an imagined future personhood for this individual, a *memento quod potuit esse*, so to speak. In the graves of older individuals, we can also observe the placement of the awl near the skull of the individual (Figure 7). However, it is documented as 'above head' and 'in front of forehead' instead of 'in front of face'. This change in position could possibly indicate a shift from imagined to established personhood. However, this is only a theory that would need a lot more data to confirm whether this observation is significant for the development of personhood.

In my current database, there are measurements of four object categories that were present in burials of both younger and older individuals, namely arm-spirals, awls, daggers, and pins (as shown in Figure 8). Generally, the objects buried with younger individuals are smaller and lighter compared to those given to older persons. This suggests that the objects are most likely chosen based on the mundane or mortuary dress.

Unfortunately, the dataset has limited information to verify whether the objects given to younger individuals represent their mundane or mortuary dress or if they were passed down as heirlooms or visions of their future. However, the size and placement of the objects in the grave could signify a progression in personhood. It would be worthwhile to investigate this further with more comprehensive datasets from other regions.

Discussion

Archaeological research regularly lacks transparency regarding the type of data used. It is often unclear whether statements about gender differences in past societies are based on data or value-laden inklings. For instance, if it is claimed that women were underrepresented or absent in a specific social system, it is unclear if this conclusion is based on the lack of preserved bones or the absence of pre-associated objects in burials that the archaeologist had defined as female. As a result, women are often side-lined or excluded from historical accounts.

Upon reflection of the assumptions discussed earlier in this paper, it has become evident that they are either inaccurate or cannot be confirmed with this dataset. For example, Kleber (2001) generally categorised awls as male objects and tutuli as female objects, yet this assumption has been proven untrue, at least for the broader river landscape of the Rhine. Awls were only discovered in graves of biologically female individuals, while tutuli were mostly buried with male individuals. Likewise, categorisations of

Figure 7. Measurements and positioning of objects buried with older individuals (*adultus-senilis*).

Id	Site	Age	Sex	Category	Length	Diameter	Weight	Position
2	Singen am Hohentwiel (55/24)	<i>adultus</i>	possibly female	arm-spiral		6.4	129.0	left arm
14	Singen am Hohentwiel (55/8)	<i>maturus</i>	possibly female	arm-spiral		7.0	190.0	right arm
33	Singen am Hohentwiel (53/04)	<i>senilis</i>	female	arm-spiral		7.3	81.0	right arm
39	Singen am Hohentwiel (52/3)	<i>adultus</i>	male	arm-spiral		6.1	20.0	right arm
40	Singen am Hohentwiel (52/6)	<i>early adultus</i>	female	arm-spiral				right arm
43	Singen am Hohentwiel (50/19)	<i>adultus</i>		arm-spiral		7.0		right arm
2	Singen am Hohentwiel (55/24)	<i>adultus</i>	possibly female	awl	4.9			above head
25	Singen am Hohentwiel (53/18)	<i>maturus</i>	female	awl	5.8		1.0	in front of the forehead
33	Singen am Hohentwiel (53/04)	<i>senilis</i>	female	awl	4.7		1.0	
41	Singen am Hohentwiel (52/10)	<i>adultus</i>		bead				at neck
41	Singen am Hohentwiel (52/10)	<i>adultus</i>		bead				at neck
2	Singen am Hohentwiel (55/24)	<i>adultus</i>	possibly female	dagger	8.9		24.0	in front of the face, under the right hand
8	Singen am Hohentwiel (55/12)	<i>adultus</i>	possibly male	dagger	8.0		18.0	next to the left arm, pointing downwards
31	Singen am Hohentwiel (58/1)	<i>adultus</i>		dagger	8.3		23.0	
32	Singen am Hohentwiel (52/5)	<i>middle adultus</i>	male	dagger	12.1		35.0	close to the pelvis
33	Singen am Hohentwiel (53/04)	<i>senilis</i>	female	dagger	6.3		18.0	on the chest, beneath the chin
35	Singen am Hohentwiel (52/22)	<i>maturus-senilis</i>	male	dagger	9.4		26.0	next to the right arm
37	Singen am Hohentwiel (52/17)	<i>middle maturus</i>	male	dagger	15.7		93.0	next to the arm
41	Singen am Hohentwiel (52/10)	<i>adultus</i>		dagger	5.8		13.0	at stomach
42	Singen am Hohentwiel (51/7)	<i>maturus-senilis</i>	male	dagger	12.5		50.0	right arm
43	Singen am Hohentwiel (50/19)	<i>adultus</i>		dagger	11.6		39.0	left side of the pelvis
2	Singen am Hohentwiel (55/24)	<i>adultus</i>	possibly female	pin	21.0		47.0	in front of the face, under the right hand
33	Singen am Hohentwiel (53/04)	<i>senilis</i>	female	pin	30.0		65.0	on chest
40	Singen am Hohentwiel (52/6)	<i>early adultus</i>	female	pin				at neck
41	Singen am Hohentwiel (52/10)	<i>adultus</i>		pin			1.5	on/in front of the chest
45	Singen am Hohentwiel (50/15)	<i>adultus</i>		pin	8.4		2.5	at the left shoulder

Figure 8. Comparison of object sizes buried with younger and older individuals in Singen am Hohentwiel.

	<i>infans I/II - juvenis</i>						<i>adultus - senilis</i>					
	length		diameter		weight		length		diameter		weight	
	range	mean	range	mean	range	mean	range	mean	range	mean	range	mean
arm-spiral			3.2-6.5	4.83	12.0-219.0	82.0			6.1-7.3	6.77	81.0-190.0	105.0
awl	2.2-4.3	3.38					4.7-5.8	5.13			1.0	
dagger	7.3				15.0		5.8-15.7	9.06			18.0-93.0	33.9
pin	7.0-13.7	10.4			3.0-13.0	8.88	8.4-30.0	19.8			1.5-65.0	29.0

objects such as daggers or ornaments as exclusively male or female have been found to be incorrect, as these items have been found in both female and male burials.

Certain object categories are common to both men and women, but some are exclusive to each sex. For instance, awls are exclusively found in female graves, while axes and tin plate tubes are exclusive to male graves. Shared object categories include daggers, pottery, tweezers, and various adornments. One object that stands out is the pin, a common feature in both male and female burials of the EBA. Therefore, I disagree with the widely held notion that ornaments should be associated with women (as argued by David-Elbiali and Hafner 2010; Feickert *et al.* 2018; Vandkilde 1996) and daggers and tweezers are associated with men (as suggested by Kimmig 1958; Kristiansen 2000; Taylor 1996).

As previously noted, distinguishing the sex of skeletal remains can be challenging due to bone degradation and ambiguous gender markers (Brothwell 1981). Nevertheless, including anthropological studies can help us to test if our current understanding of burial traditions resembles past reality.

Conclusion: One is not born, but rather dies a woman

Archaeological studies often use the term ‘gender’ loosely, leading to confusion about whether the authors are discussing biological sex or ‘cultural gender’. It is crucial to understand that the biological sex of individuals buried in the past does not necessarily align with their gender identity or personhood. Furthermore, we must acknowledge the existence of a gap between biological sex and gender expression in life, intersexuality, or a variation of characteristics. By recognising these distinctions, we can better understand the complex nature of gender and its role in past societies.

The analysis of Early Bronze Age burials in the river landscape of the Rhine has shown that certain object categories were more prevalent in graves with one sex over the other, suggesting that there may have been some objects that were sex-specific in burial traditions. Despite this, there were object categories that appeared to be shared between both male and female burials, albeit with some variations in frequency. Most significantly, the analysis has demonstrated that female and male burials exhibited many similarities regarding the object categories they shared. This suggests that there may have been more similarities than differences in how Bronze Age societies viewed death and burial practices, regardless of the buried person’s biological sex.

We also have to remember that gender and biological sex are not the same. Different stages of gender can be obtained, performed, displayed, or perceived during a person’s life, whether this person is born female or male (Butler 1990; Frieman *et al.* 2019; Stig Sørensen 2004). Femininity and masculinity can be part of this display, but they are not restricted to their biological sex, respectively.

It is often assumed that biological sex is the primary factor in the representation of personhood. However, this research suggests that age may have played a more significant role in representing personhood in burial customs. This does not imply that biological sex was irrelevant; rather, it may have had a lesser

impact compared to age. The findings of this research also demonstrate the variability of identities among different sexes and ages. Activities such as crafting, fighting, representing, and trading were not limited to a specific sex. This indicates that we need to reconsider our understanding of the past. Women, children, and older individuals, who are frequently portrayed as bystanders in archaeological narratives, actively contributed to shaping the society they lived in and they still do today.

Perspectives

To advance the theory presented in this paper, it is essential to broaden the scope of research and incorporate new data on biological sex and age. Furthermore, defining distinct time periods could help illustrate the ‘evolution’ of gender and personhood in burial practices over time. It would also be beneficial to consider ‘empty’ burials and to incorporate additional variables, such as colour and material of textiles (when preserved), the number of object categories per burial (e.g., pairs of specific objects), the orientation of the body and the placement of grave goods in relation to the buried individuals. My hypothesis proposes that various layers of identity can be identified in burials, with the types of objects and their placement reflecting the individual’s age and stage of personhood, while the body’s orientation may signify the person’s biological sex and/or gender identity.

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New research on prehistoric fortifications in Austria – Results of the Dietenberg excavations in Styria

Florian Mauthner¹ and Klaus Schindl²

Abstract

The hilltop settlement at Dietenberg (Austria) is one of the most significant sites in Styria, with a settlement history from the Chalcolithic through the Bronze and Iron Ages, to the Middle Ages. The remarkable fortification system has been of particular interest because of the ‘approach obstacles’ in front of the main rampart. The history of research, the purpose and function of these special fortification elements are discussed in the paper. The results of the excavations of the main rampart and the ‘approach obstacles’ are also presented, providing new insights to the settlement development of the Dietenberg and also to the discussion of these remarkable fortification elements.

Key words: Hilltop settlement, fortification, ramparts, Iron Age

Résumé

L’habitat de hauteur de Dietenberg (Autriche) constitue l’un des sites les plus importants de Styrie, avec une séquence d’occupation s’étendant du Chalcolithique jusqu’au Moyen Âge, en passant par les âges du Bronze et du Fer. Son remarquable système de défense a suscité un intérêt particulier en raison de la présence d’« obstacles d’approche » situés à l’avant du rempart principal. Cet article examine l’historique des recherches, ainsi que la destination et la fonction de ces éléments de fortification spécifiques. Les résultats des fouilles du rempart principal et des obstacles d’approche sont également présentés, apportant de nouveaux éclairages sur le développement de l’habitat de Dietenberg et contribuant au débat sur ces structures défensives singulières.

Mots-clés: Habitat de hauteur, fortification, remparts, âge du Fer

The hilltop settlement on Dietenberg in the vicinity of Ligist (Styria/Austria) is considered to be one of the most significant archaeological sites in Styria with a remarkable settlement history. The defensive structure, which is particularly conspicuous, is the focus of archaeological research; the primary research results will be discussed in this article.

Topography

The Dietenberg is an island-like elevation, surrounded by rivers to the north-east (Ligist creek) and west (Kainach river), forming the north-western end of the Kainach valley, which extends wide up to this point (Figure 1).

The topographical features of this site include steep slopes and an east-west plateau, which results in the formation of a natural barrier to the north-west. This topographical feature also offers a panoramic view of central and western Styria, extending as far as the Slovenian border. In addition to this strategically significant vantage point, the mountain is also situated at a pivotal nexus in terms of transport geography. It is located along the route from southern and western Styria, traversing the Gaberl Pass to Upper Styria, or via the Pack Pass to Carinthia.

The Dietenberg site is comprised of the aforementioned settlement plateau at the summit, and steep slopes equipped with artificial settlement terraces and an associated complex defence system. This system consists of seven still recognisable, artificially constructed settlement terraces, each protected by a rampart, thus enabling a staggered defence. It can be assumed that the southern slope, which is now characterised by viticulture, had a similarly complex system, but it has been completely destroyed.

¹ Erlebnis Archäologie and Archeo Norico Burgmuseum Deutschlandsberg; florian.mauthner@gmx.net

² Erlebnis Archäologie; klausschindl@gmail.com

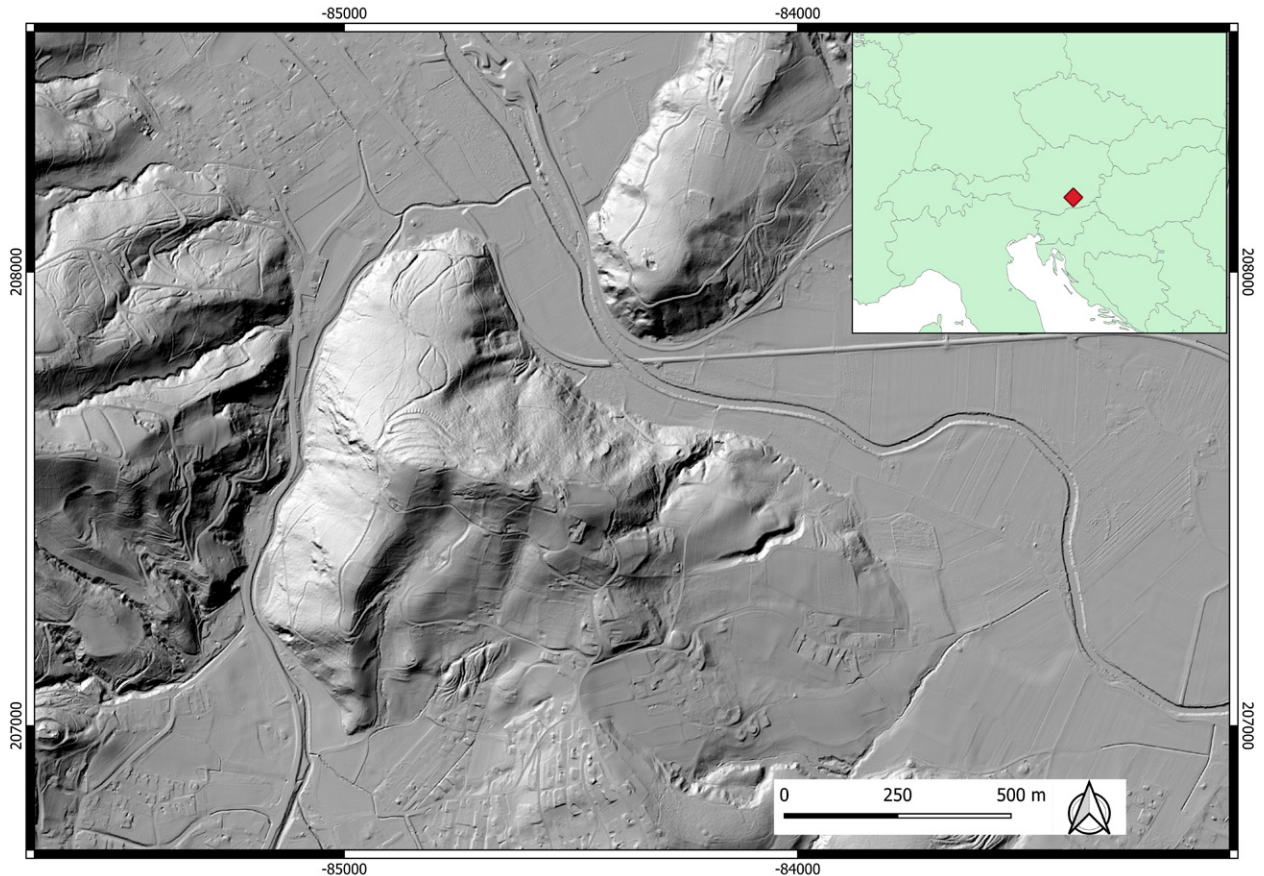


Figure 1. Location and surrounding area of the Dietenberg (Based on ALS-Data by BEV, Graphics: F. Mauthner).

The access route to the settlement is believed to have been via a gateway to the east, which has since been obscured by the medieval overprint and a modern water reservoir. The second entrance, which remains visible to this day, was from the north via a hollow path that is still in evidence, extending up to approximately halfway up the hill. At this point, a barbed gate was positioned to secure the interior of the settlement. From this gate towards the east, the primary rampart is flanked by transverse ramparts, known as 'Reitergassen', in the direction of the access path, which formed the focal point of the present research study (Figure 2).

Chronological overview

The earliest traces of settlement on the Dietenberg were identified in the Copper Age (5th/4th millennium BC), and these included pottery and stone tools, with particular attention being paid to arrowheads (Kramer 1981: 220, s.v. 482 Ligist) and a clay roller stamp. Two comparable pieces of the latter artefact have been found in St. Stefan ob Stainz and on the Frauenberg near Leibnitz (Tiefengraber 2018: 236)

The succeeding Urnfield Period (11th – 9th century BC) is characterised by the presence of spearheads, garment needles and a diverse array of ceramic vessels, with a notable lunar idol fragment or fire trestle also being identified. In addition to some characteristic fragments from the Hallstatt period (Ha C, 8th/7th century BC), the features and finds from the later Iron Age, also known as the Latène period, between the late 4th century and the 1st century BC are of particular importance. In the summit area of the Dietenberg, a building with a base area of 12 x 8 metres was uncovered during research excavations by the Universalmuseum Joanneum. The foundations of the building consisted of clay-mortared bedrock and stone slabs, and the finds unearthed inside the building included pottery, mainly from the Late

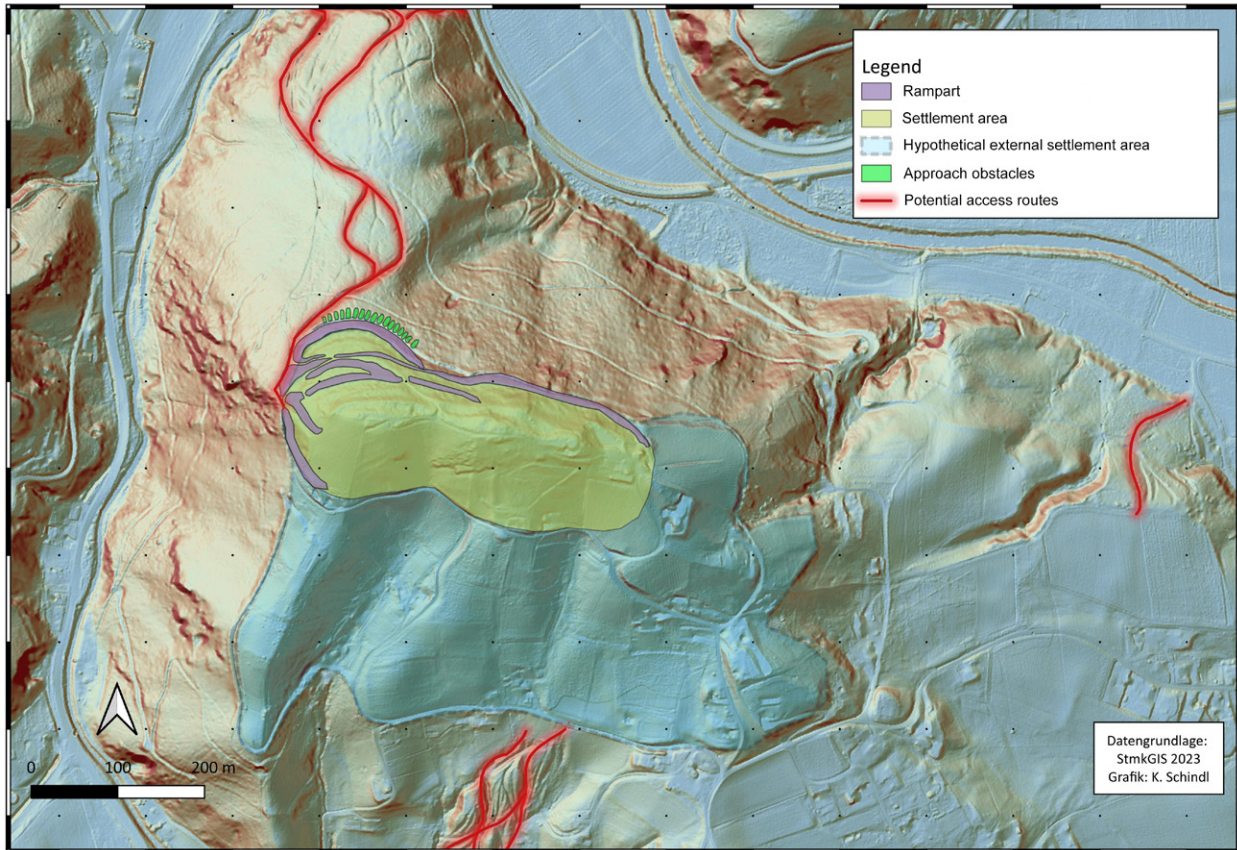


Figure 2. Topography and settlement structure of the Dietenberg (Graphics: K. Schindl).

Latène period, as well as remains of clay plaster and iron artefacts (Kramer 1980: 171–184). Further house foundations can still be seen in the area and on the settlement terraces.

A final phase of utilisation can be traced back to the Middle Ages, where the so called Dietenburg, one of the three earliest castles in Styria, was probably located in a spur-like position in the eastern area of the summit plateau. Isolated medieval artefacts are known from this area, but the site was probably abandoned in the 12th century after the construction of Ligist Castle and was largely destroyed during the construction of water reservoirs (Murgg and Lehner 2010: 153, 163).

The phenomenon of ‘approach obstacles’

The special fortification of the hilltop settlement on Dietenberg was now the focus of research and also represents a rare phenomenon of prehistoric defensive structures with transverse ramparts or ‘approach obstacles’. These defensive structures, so-called ‘riding lanes’, which is a literal translation from the German term ‘Reitergassen’, are particularly widespread in Central Europe, but quite rare (Schneider 1977: 67–72; Schwarz 1971: 222–238). The term ‘Riding lanes’ does not represent a *terminus technicus* here, however, but is primarily based on the first research on this topic in the 1960s. These constructions have been, and continue to be, directly associated with so-called ‘Hungarian refuges’, which are said to have served as fortifications against the threat of Hungarian cavalry groups on older, existing ramparts by means of simple earth mounds. The co-occurrence of the Hungarian ramparts with the obstacles often led to the dating of all fortifications with at least one of these features directly to the Hungarian period (Boos and Schmitz 2012: 160; Ettel 2012: 62). Excavations were not conducted at these southern German defensive structures, yet the Hungarian theory was upheld despite the dearth of medieval finds and the paucity of prehistoric material. This research-historical fallacy was recently presented in great detail

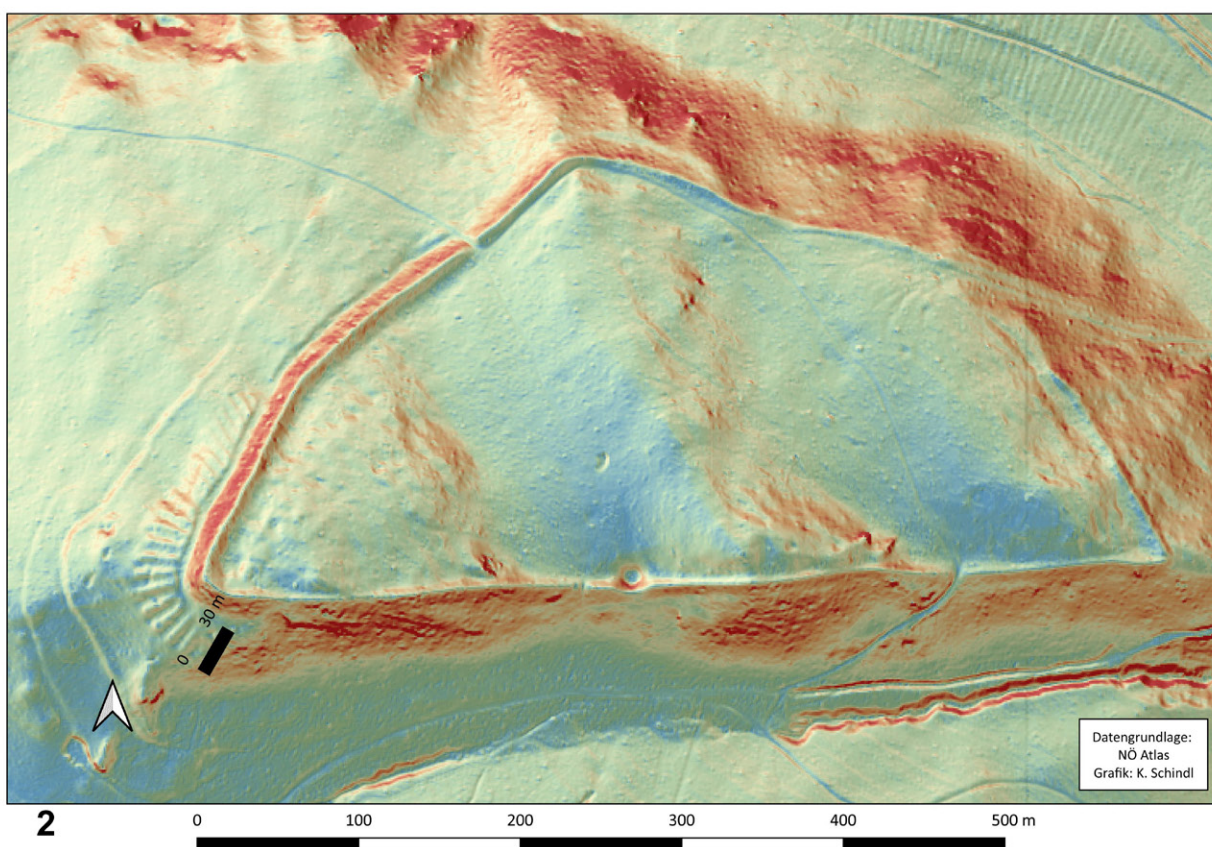
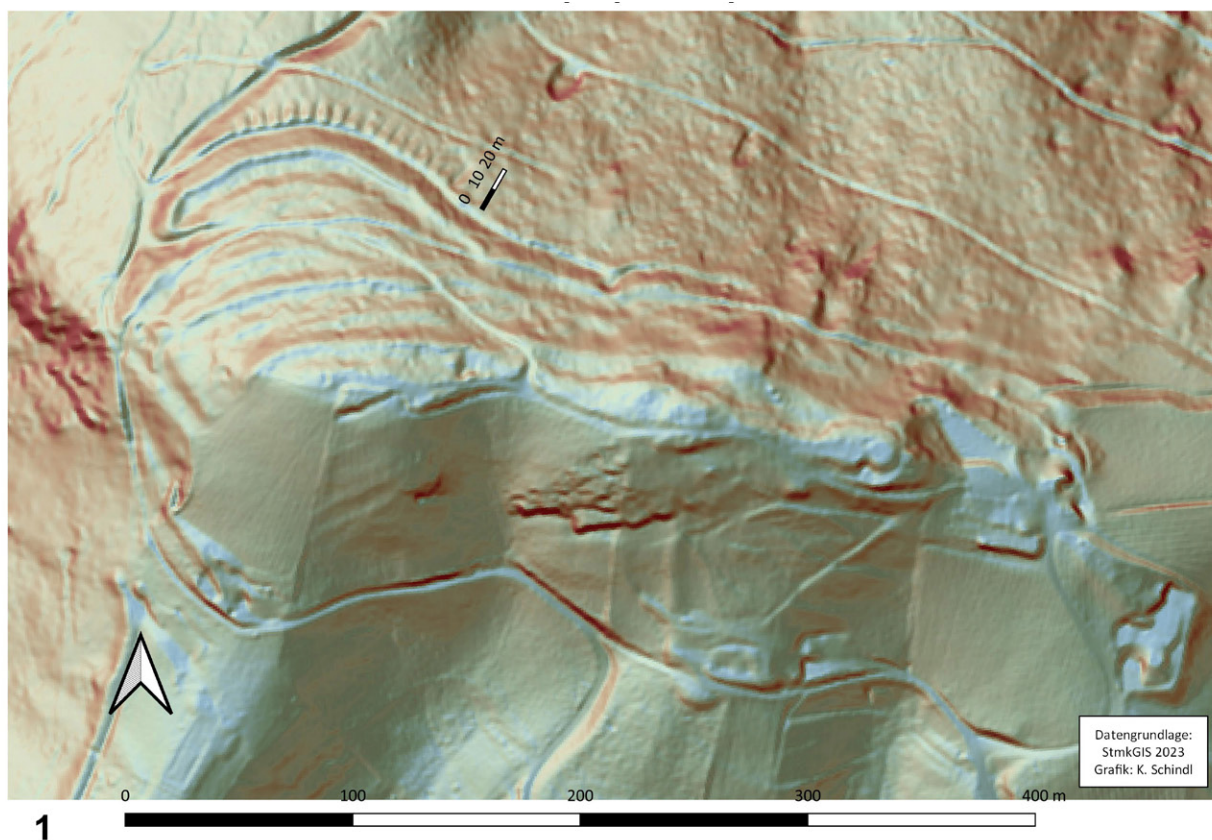


Figure 3. Examples of approach obstacles: 1. Dietenberg, Styria, Austria; 2. Michelstetten, Lower Austria (Graphics: K. Schindl).

in the most comprehensive work to date on the subject of such ‘Riding obstacles’ (Schußmann 2022: 493–510).

The configuration of such approach obstacles was achieved through the implementation of a relatively uniform layout. They usually run at right angles to a rampart, whereby there is always free space or a ditch between the rampart and cross-bars. However, they vary greatly in length from around five to over 30 metres with an approximate distance of five to 10 metres between them. The number of obstacles also varies considerably, with the quantity always adapted to the terrain. They are always located at weak points in fortifications, usually where there is little or no natural protection provided by slopes (Figure 3).

Approach obstacles of this nature can be broadly categorised into three distinct groups: The first group was constructed in the form of embankments, which can be further subdivided into two categories: embankments with an average length of less than 10 metres and embankments with a length of more than 20 metres. Secondly, they manifest as excavated pits without backfill. Thirdly, they appear in the form of chessboard-like fields staggered in several rows.

Purpose and function

Theories as to the purpose of such defences remain entirely hypothetical. One widely popular explanation is to keep mounted archers at a distance and prevent them from riding along the wall. While it is impossible to disprove this theory without written sources, there are some arguments against it:

- Attacking a fortress on horseback is only partially effective. Riders would have to dismount to climb over the ramparts.
- The use of archers as skirmishers, firing arrows in a parabolic trajectory into the interior of the fortress, is effective. Even the longest approach obstacles of groups 1 and 2 are too short for such shooting distances of at least 50 metres (Szabo *et al.* 2021: 43–52). The only exception is the Birg near Hohenschäftlarn, whose Group 3 obstacles are over 50 metres deep.
- The cost of constructing such entrenchments is relatively high compared to other methods of effectively fighting cavalry. Simple wooden constructions, such as the well-known ‘chevaux de frise’ of modern times, are usually sufficient. A horseman does not dismount in the midst of battle to remove obstacles – unlike an infantryman, who does not allow his path to be blocked so easily.

From this point of view, their primary use as a protection against cavalry seems unlikely. More effective would have been these crossbars, which formed several narrow lanes in which – as in the specific case of the Dietenberg – a pointed ditch was placed to slow down the soldiers of infantry and prevent them from reaching the rampart. Once inside the ditch, the battle groups were split up, and their limited manoeuvrability to the left and right made them easy targets for defenders with long-range weapons. This theory is plausibly illustrated by the castle complex of Esesfelth (Schleswig-Holstein), which is described as a ray ditch (Lemm 2012: 80).

Dating

The widely accepted dating to the time of the Hungarian invasions is currently not tenable due to a lack of archaeological evidence. Five research projects, including Dietenberg, have so far provided reliable data. The geographical and temporal spread of comparable sites over more than five millennia is surprising.

- Provadia Solnitsata (Bulgaria) – c. 4600 BC (Nikov 2022: 138–140).
- Hinterer Berg (Bavaria, Germany) – 9th century BC (Schußmann 2022: 499–500).
- Dietenberg (Styria, Austria) – 1st century BC.
- In den Gleiern (North Rhine-Westphalia, Germany) – 2nd–1st century BC (Cichy 2015: 185–186).
- Esesfelth (Schleswig-Holstein, Germany) – 7th century AD (Lemm 2014: 357).



Figure 4. Trench through the main rampart (F. Mauthner).

Given the vast geographical extent of such obstacles to access, it cannot be ruled out that the majority of comparable archaeological monuments have already been levelled and are therefore no longer recognisable. It appears to be a tried and tested element of fortification, used under certain conditions – whether topographical or technological – and in a wide variety of periods.

Dietenberg excavations 2023

During the excavation, three trenches were made on the northern slope, kindly permitted by the landowner and carried out by Erlebnis Archäologie in cooperation with the Archäologisch-Soziale Initiative Steiermark and the Archeo Norico Burgmuseum Deutschlandsberg, with the active help of volunteers from Germany, Switzerland and Austria, as well as local heritage researchers.

A trench was cut in the area of the lowest terrace, where the topography suggested the presence of a main rampart, so the trench was opened from the northern slope of the site, over the rampart and the terrace behind it, to the slope rising to the south (Figure 4). A massive erosion layer was found in this cut, in which a number of fragments of Late Latène pottery were found. In the area of the rampart, a concentration of upturned stones was uncovered, probably part of a rampart collapse, which was filled with loose erosional debris and in which Late Neolithic pottery and a spindle whorl were also recovered. During the excavation of this ‘rampart construction’, the remains of two layers of local quarry stone were uncovered in the lower part, the space between which was filled with loose, surrounding erosion material and which may represent the original construction of the rampart/probably the first construction phase of the fortification. A continuous, loamy layer was documented beneath the aforementioned erosion



Figure 5. View on the approach obstacles from the main rampart (F. Mauthner).

layer and the rampart construction, in which isolated pieces of Iron Age pottery were found. Remarkably, no evidence of settlement activity, apart from three postholes, was found in the area of the terrace, i.e. between the embankment and the slope to the south.

To the north below, two sections were made at the approach obstacles to determine their structure and date of construction (Figure 5).

One section was made in the upper area of the approach obstacles to understand the possible connection to the adjacent slope to the south, which had been partially destroyed by the construction of an older forest track, while a second section was made further east in the lower area of the approach obstacle to provide further information. Both sections showed that the construction of the access barriers was the same. Existing rubble was dumped and a deep (in places up to 1.6 metres) pointed ditch was dug between the ramparts, with stones laid on top to form a crown (Figure 6).

In the upper, southern area, the ramparts are unfortunately disturbed by a forest track, but remains of the former construction have been recorded. The ramparts ran up the natural slope to the south, where a layer of stones arranged almost in a semicircle blocked the moat, making access impossible. South of these stones, under and between which fragments of Late Latène pottery were found, an east-west ditch had been dug at the foot of the rising slope, probably to drain surface water from the slope and protect the approach obstacles from flooding.

Fragments of pottery dated to the Latène period have been recovered from all of the excavated trenches, as well as from the pointed ditch, the stone layers of the approach obstacles and the erosion layers. The sherds are made of fine, lean, soapy clay, ochre to light brown and rarely light grey. The ceramic forms include barrel-shaped pots, bulbous pots and bottle-like conical-necked vessels, as well as fragments of



Figure 6. Lower part of the approach obstacles (F. Mauthner).

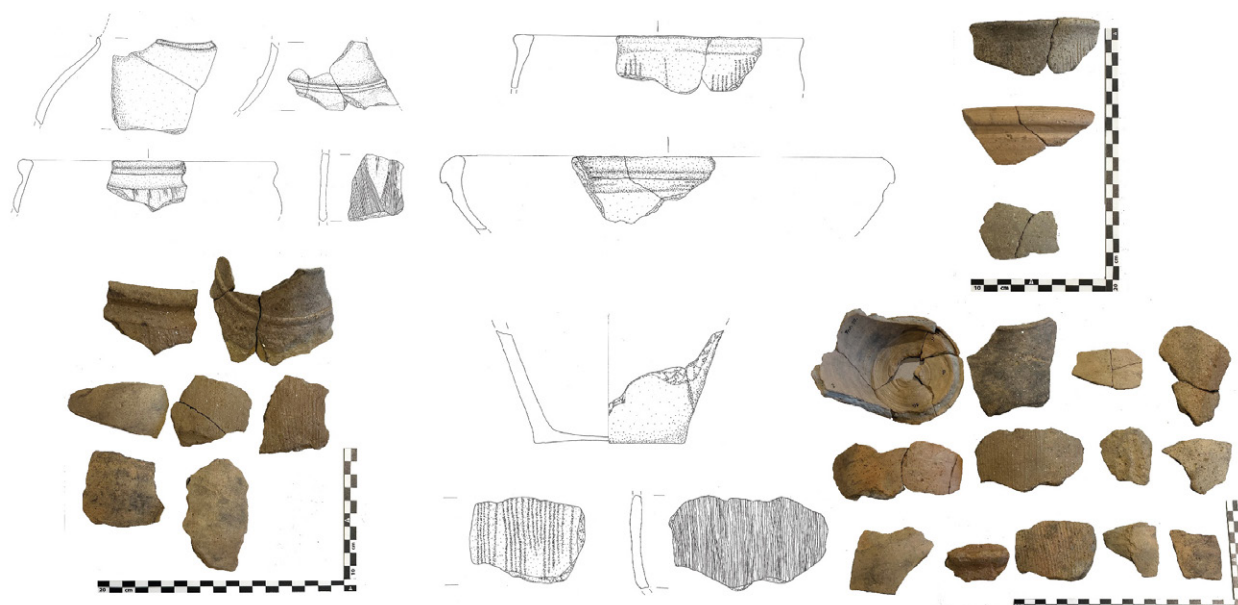


Figure 7. Ceramic findings from 2023 excavation (Drawing: V. Vidoz, Pictures: F. Mauthner).

bowls. Based on comparisons with other sites in western Styria, especially graves and settlements from the La Tène period, The pottery fragments recovered during the excavation of the rampart fills and ditches indicate that the main rampart and the approach obstacles in front of it were constructed at the end of the Late Latène period in the 1st century BC (Figure 7).

Summary

The objective of the 2023 excavations on the Dietenberg was to ascertain the dating and construction of the remarkable defensive structure. The cross-bars on the Dietenberg were constructed by heaping up locally available stony rubble material, which was then laid up to form ramparts with local platy stones placed on top to reinforce them. Between these ramparts, narrow pointed ditches up to 1.6 metres deep were created, probably also as a result of the embankments, which severely restricted the manoeuvrability of approaching soldiers. The upper end of these pointed trenches was closed off by a stone construction which led from rampart to rampart in a semi-circular shape. Behind this construction was a transverse ditch which diverted the water coming from the slope behind to protect the approach obstacles from flooding.

The dimensions of the ‘riding lanes’ on the Dietenberg, which range from 7.7 to 10 metres in length, in conjunction with the construction of the pointed ditches, suggest that their primary function was likely to be the defence of foot soldiers rather than the obstruction of cavalry.

In its first construction phase, the main rampart on the lower settlement terrace was probably originally built using the clamshell technique, where two cheeks of local rock were built and filled with local earth. Local stones and earth were later piled on top of this construction to give the rampart stability.

The artefacts discovered within the ramparts and the approach obstacle ditch provide a comprehensive historical perspective, specifically dating back to the 1st century BC. The absence of subsequent finds indicates a single-phase construction activity and a relatively brief period of utilisation.

The settlement on the Dietenberg played an important role in the Late Iron Age, in addition to its use during the Copper Age and Urnfield Period. This conclusion is supported by the uncovering of the building at the summit and the large number of finds from the Latène Period. The construction of the remarkable defensive structure with a main rampart and approach obstacles in the 2nd century BC appears to have been necessitated by a threat. The extent to which the higher settlement terraces also belong to this period remains to be determined due to the paucity of excavations. However, the absence of settlement remains behind the main rampart suggests the potential for a large retreat complex to have been constructed here, providing refuge for the population of the surrounding area in times of emergency.

However, these excavation results are also of great importance for the approach obstacles research, as a prehistoric construction period was determined here and thus a medieval-Hungarian period dating of these facilities could once again be revised.

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Underwater hillforts: Assessing the opportunities and challenges of flood-prone archaeological sites

Pablo Paniego Díaz,¹ Lucía Ruano Posada,² Iratxe Boneta Jiménez³ and Timoteo Rivera Jiménez⁴

Abstract

Archaeological sites affected by fluctuating water levels remain underrepresented in research and management strategies. In southwestern Spain, the region of Extremadura contains numerous examples due to an extensive network of inland waters. This study explores the application of Geographic Information Systems to assess the vulnerability of submerged and flood-prone heritage and support targeted conservation efforts. Two case studies illustrate the approach. The first combines Areas of Potential Significant Flood Risk maps with archaeological data to identify high-risk zones along the Guadiana River. The second examines the protohistoric hillfort of La Tabla de las Cañas, currently located within the flood zone of the La Serena reservoir. Recent droughts have exposed the site, enabling documentation through UAV-based photogrammetry and centimetre-precision GNSS, while also revealing the extent of ongoing erosion. These methods offer a replicable framework for monitoring, evaluating and mitigating the impact of fluvial morphogenesis on archaeological heritage in increasingly unstable environmental contexts.

Key words: Inland reservoir archaeology, LiDAR, UAV-based survey, archaeological heritage protection, topographic restitution

Résumé

Les sites archéologiques affectés par les fluctuations du niveau de l'eau demeurent sous-représentés dans les stratégies de recherche et de gestion. Dans le sud-ouest de l'Espagne, la région de l'Estremadure en offre de nombreux exemples en raison d'un vaste réseau d'eaux continentales. Cette étude explore l'application des Systèmes d'Information Géographique pour évaluer la vulnérabilité du patrimoine submergé ou sujet aux inondations, afin de soutenir des efforts de conservation ciblés. Deux études de cas illustrent cette approche. La première combine les cartes des zones à risque potentiel d'inondation significatif avec les données archéologiques pour identifier les zones à haut risque le long du fleuve Guadiana. La seconde examine l'éperon barré protohistorique de La Tabla de las Cañas, actuellement situé dans la zone d'inondation du réservoir de La Serena. Les sécheresses récentes ont exposé le site, permettant une documentation par photogrammétrie par drone (UAV) et GNSS de précision centimétrique, tout en révélant l'ampleur de l'érosion en cours. Ces méthodes offrent un cadre reproductible pour surveiller, évaluer et atténuer l'impact de la morphogenèse fluviale sur le patrimoine archéologique dans des contextes environnementaux de plus en plus instables.

Mots-clés: Archéologie des réservoirs continentaux, LiDAR, levé par drone, protection du patrimoine archéologique, restitution topographique

Introduction

The Autonomous Community of Extremadura is located on the Atlantic façade of the Iberian Peninsula and has the longest inland shoreline of any Spanish region, exceeding 1500 km (Hernández Mogollón 2008: 219). The southern half of the region, roughly corresponding to the province of Badajoz, lies within the Guadiana River basin. This system is characterised by significant interannual variability in precipitation, leading to prolonged droughts followed by years of heavy rainfall (García Marín and Mateos Rodríguez 2010: 89). It also experiences pronounced seasonal variability, with extreme fluctuations in river flows, resulting in both severe floods and prolonged low-water periods (García Marín and Mateos Rodríguez 2010: 96). These irregularities have been a key factor in the construction of extensive hydraulic infrastructure throughout Extremadura, leading to the regulation of most river courses (García Marín and Mateos Rodríguez 2010: 89). As a result, the Guadiana features a vast network of canals and reservoirs, among which the Alqueva reservoir (between Alentejo, Portugal, and Badajoz, Spain)

¹ Institut für Archäologische Wissenschaften, Universität Freiburg; pablo.paniego@ufg.uni-freiburg.de

² UNIARQ, Universidade de Lisboa; lucia.ruano@edu.ulisboa.pt

³ Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid; Arqueozoo S.L.; iratxe.boneta@uam.es

⁴ Centro Andaluz de Desarrollo Económico de Cala; tinorivera17@gmail.com



Figure 1. Location of the study area: Middle Guadiana Basin.

and La Serena reservoir (Badajoz, Spain) stand out as major hydrological projects. This irregularity in precipitation results in significant fluctuations in river flows and reservoir water levels. Periodic flooding caused by unpredictable heavy rainfall, coupled with fluctuations in reservoir levels, create a challenging environment for the preservation of archaeological heritage, making many sites highly vulnerable.

The aim of this study is to demonstrate how Geographic Information Technologies (GIT) can aid in the preservation of archaeological heritage, particularly in dynamic fluvial and reservoir environments where water level fluctuations pose a significant challenge. To illustrate this, we examine two case studies that represent different but complementary approaches to heritage management in flood-prone areas (Figure 1). The first case study focuses on riverbank sites along the Guadiana, where the use of Areas of Potential Significant Flood Risk (APSFR) maps can assist heritage management authorities in mitigating flood-related damage through preventive and emergency measures. The second case study examines the protohistoric site of La Tabla de las Cañas, located within the flood zone of La Serena reservoir. This site undergoes recurrent cycles of submersion and exposure due to fluctuating water levels, leading to significant degradation processes. While these cycles pose a preservation challenge, they also present a unique research opportunity, as they have gradually exposed previously unrecorded archaeological features, including structural remains. By employing high-precision GNSS and drone-based photogrammetry, this study proposes a methodological framework for documenting and monitoring the site's degradation over time, contributing to a broader understanding of the impact of hydrological dynamics on archaeological heritage.

Submerged heritage in Extremadura (Spain) and its vulnerability

At the end of the 20th century, the Spanish government delegated the management of its cultural heritage to the autonomous communities.⁵ One of the key measures implemented for the protection of the heritage was the development of archaeological inventories, aimed at safeguarding sites through their delineation and georeferencing. Furthermore, in the early 21st century, the European Directive on the Assessment and Management of Flood Risks⁶ led to the creation of flood risk maps under the designation of Areas of Potential Significant Flood Risk (APSFR).

Despite the potential benefits of integrating these two types of data – archaeological inventories and flood risk maps – this approach remains largely underutilized. In Spain, their combined use is particularly limited, and their application has generally not been oriented toward the protection and safeguarding of cultural heritage (Rodríguez *et al.* 2021; Rodríguez and Paniego 2021). In fact, there are very few studies in Spain that assess the impact of riverine floods on archaeological heritage (Díez-Herrero 2019). By contrast, in other countries, research has been conducted on the effects of fluvial flooding on cultural heritage (Drdácký 2010; Figueiredo *et al.* 2020; Holický and Sýkora 2010; Lee *et al.* 2014; Stephenson and D'Ayala 2014), and the European Commission has even promoted a project aimed at evaluating this risk.⁷ One of the key objectives of this initiative was the classification of cultural heritage – both movable and immovable – according to its vulnerability to flooding.

Maps that integrate archaeological data with potential flood risk assessments offer a valuable tool for identifying the most vulnerable sites, as advocated by the European Commission project. These maps not only highlight heritage sites at greater risk of flooding but also help define zones where cultural assets are particularly exposed to such events. In the case of Extremadura, the application of APSFR mapping for heritage protection is especially relevant, as this region has the longest freshwater shoreline of any autonomous community in Spain (Hernández Mogollón 2008: 219).

Moreover, in the case of Extremadura, the high number of reservoirs has led to a significant portion of its archaeological heritage being either permanently submerged or located within reservoir flood zones. This situation increases the risk to heritage sites, particularly those within flood-prone areas, as they are subject to periodic fluctuations in water levels. In recent years, interest in this type of heritage has grown, leading to several studies focused on submerged archaeological sites in dammed inland waters, as well as some targeted interventions – primarily in the Tagus River basin (Aguilar-Tablada and Sánchez 2006; Arcos García 2023; Cerrillo-Cuenca *et al.* 2024; Gamo *et al.* 2022; Gordón *et al.* 2022; Matamoros and Cerrillo-Cuenca 2013; Matamoros *et al.* 2014; Salgado 2017). This growing concern has even resulted in the development of a specific action protocol (Villa González 2023). However, despite these advances, a comprehensive mapping of submerged archaeological heritage in Extremadura remains far from complete, particularly in the Guadiana basin, where archaeological interventions in reservoirs have been scarce (e.g. Jiménez Ávila 2001).

This study focuses on a 25-kilometer stretch of the Guadiana River in the eastern part of Badajoz province, spanning the municipalities of Villanueva de la Serena, Don Benito and Medellín. The integration of multiple data sources will allow for an initial assessment of the risks that river flooding poses to archaeological heritage in this section of the river.

⁵ In the case of Extremadura: Royal Decree 3039/1983, of 21 September, on the transfer of functions and services from the State to the Autonomous Community of Extremadura in the field of culture. <https://www.boe.es/eli/es/rd/1983/09/21/3039>

⁶ Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32007L0060>

⁷ Cultural heritage protection against Flood (CHEF). <https://cordis.europa.eu/project/id/44251>



Figure 2. La Tabla de las Cañas hillfort: a) Low reservoir level; b) Medium-high reservoir level.

The archaeological site of La Tabla de las Cañas

The archaeological site of La Tabla de las Cañas is located on the right bank of the Zújar River, a tributary of the Guadiana, within the municipality of Capilla (Badajoz), on the border between the Extremadura regions of La Serena and La Siberia (318409 / 4302280 ETRS89, Zone 30N). Despite its proximity to the river, the settlement was historically safe from periodic flooding, as were the nearby necropolises. However, with the construction of La Serena reservoir – managed by Confederación Hidrográfica del Guadiana (CHG) – the site is now situated within its flood zone. As a result, La Tabla de las Cañas remains submerged for extended periods, though fluctuations in water levels periodically expose the site (Figure 2).

The site was first identified in the late 20th century through isolated finds, including the so-called *Sileno de Capilla* (Olmos 1977), an as coin from Obulco and a hoard of Andalusí coins (Domínguez de la Concha and García Blanco 1991: 237). Subsequent investigations in the vicinity of these discoveries led to the documentation of a fortified settlement. In the late 1980s, as part of the La Serena Reservoir Action Plan, the site underwent its only archaeological intervention, carried out by M.^a Coronada Domínguez de la Concha and Julián García Blanco. Despite the significant results of this excavation – which confirmed the presence of well-defined pre-Roman occupation levels, making it one of the few Late Iron Age (LIA) settlements in the province of Badajoz documented through excavation – no further archaeological work followed. The lack of continued research was primarily due to the site's prolonged submersion under the reservoir's waters. Additionally, the findings from this excavation were only briefly published in 1991 in an article authored by the directors of the intervention (Domínguez de la Concha and Blanco García 1991).

In recent years, the reservoir's water levels have dropped to below 13% of its total capacity, exposing the site to degradation processes. These fluctuations have not only affected the site's topography but have also revealed previously undocumented features in its surroundings, providing a unique opportunity for archaeological investigation. Between 2022 and 2024, taking advantage of this situation, several archaeological interventions were carried out both within the settlement and in its immediate surroundings. The first campaign consisted of a surface survey in the surrounding area, which led to the identification of three necropolises located between 300 and 500 meters from the settlement (Paniego Díaz *et al.* 2026), situated approximately 300 meters from the site and visible from it, contained urns with cremated human remains along with associated grave goods. Both necropolises were identified as urn cremation cemeteries and attributed to the LIA (4th–2nd centuries BC), directly linking them to the settlement. The third necropolis, in contrast, lacks visual connectivity with the settlement and exhibits distinct structural features. It is characterised by square, rectangular and circular stone structures made of river cobbles (*encachados*). In 2023, two of these structures and a cist at the edge of the necropolis were excavated. Unlike the other burial areas, the recovered remains suggest that this was an Early Iron Age (EIA) necropolis (7th–5th centuries BC).

In 2022, a surface survey was also conducted within the settlement itself, aiming to document the various structures visible on the surface. Most recently, in 2024, an excavation was carried out in one of the rectangular structures located on the southwestern flank of the settlement, near the perimeter wall (Figure 3). This trench revealed two distinct occupational phases. The first, dated between the 2nd and 1st centuries BC, corresponds to the initial phase of Roman presence in the region. Beneath this level, a second occupation layer was identified, belonging to the LIA. In addition to notable changes in material culture, this earlier phase also exhibited significant differences in construction techniques. During the pre-Roman phase, the foundations and lower sections of the walls were built using rows of river cobbles, upon which three courses of adobe bricks from the original walls were preserved. In the later Roman Republican phase, the pre-existing walls were modified: their tops were levelled and reinforced with large, roughly hewn stone blocks in a pseudo-cyclopean style, forming the base for the new constructions. The remains of this later phase were identified on the surface during the 2022 survey, naturally exposed due to erosion caused by the fluctuating water levels of La Serena reservoir.



Figure 3. Excavation trench at La Tabla de las Cañas hillfort (2024), showing the different occupation phases of the settlement (Photo: Jesús Amazares Calderón).

The prolonged submersion of La Tabla de las Cañas beneath the waters of the reservoir (Figure 4) has not only significantly altered its topography but also limited access to the necessary topographic data for its reconstruction. The objective of this study is to present various methodological approaches for reconstructing the site's topography, compare their effectiveness and provide an updated assessment of its current state and the impact of degradation since the reservoir's construction nearly 50 years ago. This combination of methods, along with an evolutionary analysis of the site's topography, will also allow us to propose corrective and preventive measures aimed at its conservation.

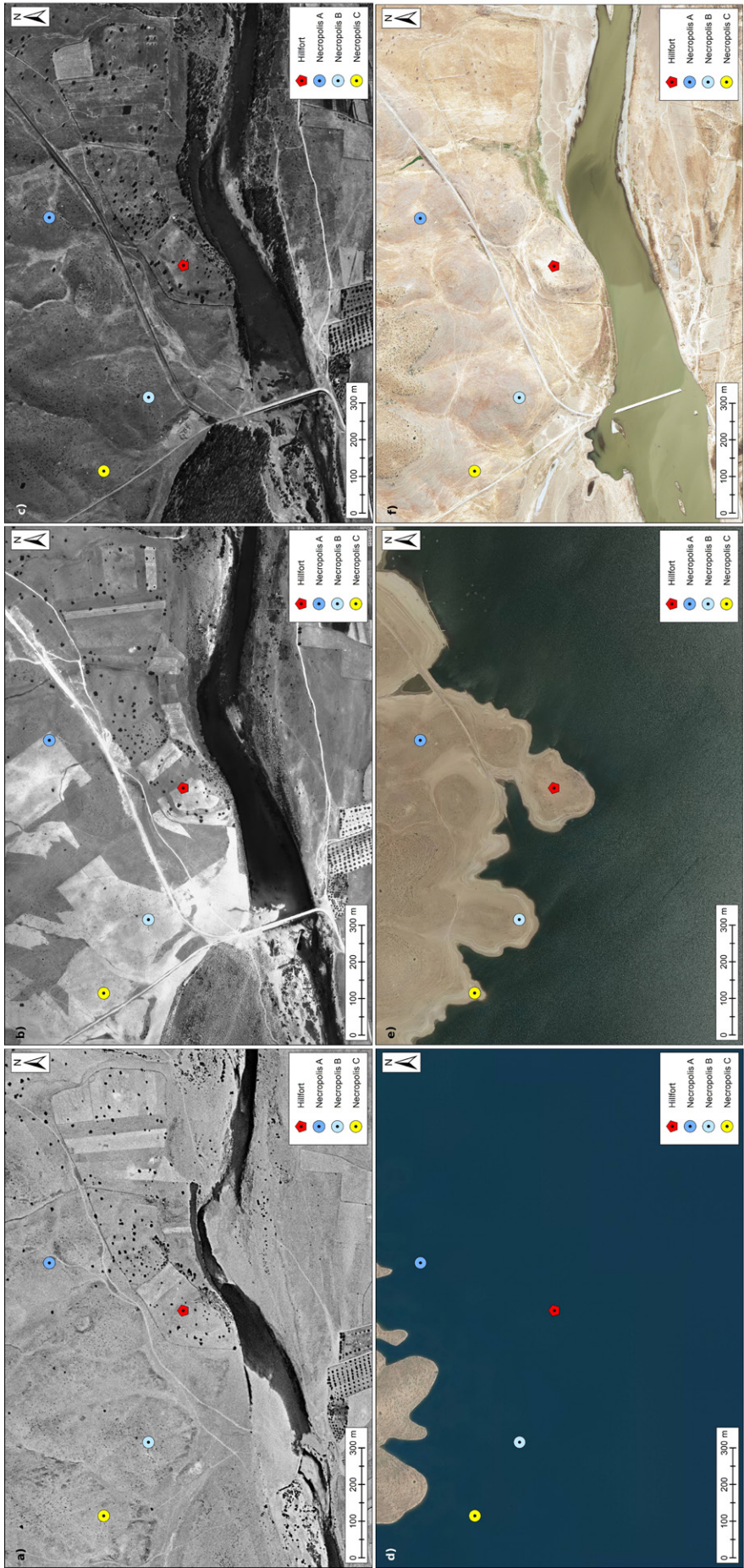
Methodology

Data source

The Autonomous Community of Extremadura holds full authority over the historical and archaeological heritage within its territory. Among the measures implemented by the regional administration is the creation of an archaeological inventory, which compiles all documented sites – whether identified through systematic surveys or excavations, isolated finds or historical references. Wherever possible, these archaeological sites have been delimited, georeferenced and assigned to a specific chrono-cultural horizon (e.g., Bronze Age, Middle Ages, etc.). The basic unit of analysis within this inventory is the municipality.

Although archaeological data are public, access is restricted. A formal and justified request must be submitted to the Directorate-General for Libraries, Archives and Cultural Heritage of the Regional Government of Extremadura in order to consult them. The georeferenced data are provided in *.shp format using the ETRS89 UTM Zone 30N reference system (EPSG 25830), which is also employed in this study.

In contrast to archaeological data, a wide range of cartographic resources is freely available and open-access in Spain. These datasets are provided by both the central government and the regional administrations. At



the national level, cartographic information – both raster and vector formats, including LiDAR data from the National Aerial Orthophotography Plan (PNOA) – is supplied by the National Centre for Geographic Information (CNIG), an autonomous body of the National Geographic Institute (IGN) and is distributed through its Download Centre. In the case of LiDAR data, three coverage sets with varying point densities are currently available: the first (2009–2011) with a density of 0.5 points/m², the second (2018–2019) with 1 point/m² and the third (2022–2025) with 5 points/m².

Access to satellite imagery from the Copernicus Land Monitoring Service of the European Union's Sentinel programme⁸ is also free of charge. Although this service provides images at a lower resolution than those offered by PNOA, it has the significant advantage of delivering multiple images per month. This temporal frequency allows for close monitoring of changes in water levels in reservoirs through several aerial images each month. In this study, Sentinel-2 data with the 'Highlight Optimised Natural Colour' visualisation were used.

With regard to flood risk maps, Directive 2007/60/EC on the assessment and management of flood risks was transposed into Spanish legislation through Royal Decree 903/2010. Article 5 of this decree mandates each River Basin Authority to conduct a Preliminary Flood Risk Assessment (APSFR). The results of this assessment have been made freely available to the public by the Ministry for Ecological Transition and Demographic Challenge and can be downloaded from the CNIG Download Centre.

The APSFR return period zones are divided into three categories. The first, referred to as T10, encompasses areas potentially affected by flood events occurring every 10 years. T100 corresponds to areas exposed to flood events with a 100-year return period, while T500 designates zones that could potentially be inundated by events occurring every 500 years.

A final source of cartographic information employed in this study comprises the expropriation plans for the construction of the La Serena reservoir, built during the 1980s. These data originate from the Guadiana River Basin Authority (CHG), which provided us with scanned copies of the original plans. The information supplied by the CHG has proven essential for understanding how the reservoir has altered the site's topography. Due to their high reliability and precision, these plans have been used as a baseline for topographic reconstruction – offering a more accurate alternative to previous attempts that relied on data from the 1946 National Topographic Map in the Tagus basin (Cerrillo-Cuenca 2011: 151).

In addition to the aforementioned public data sources, we carried out our own data acquisition to reconstruct the topography of the site using UAV technology, as well as to conduct a detailed survey of the surface-visible remains within the pre-Roman hillfort of La Tabla de las Cañas. Data collection was undertaken using a DJI AIR2S UAV, equipped with a 20 MP resolution camera. The flight was pre-planned using the DroneDeploy platform, employing a double grid pattern at an altitude of 30 metres, with 70% overlap between image pairs. A total of 660 photographs were captured and processed using Agisoft Metashape software with maximum resolution settings. The resulting model successfully aligned 623 cameras, producing an orthophoto and Digital Elevation Model (DEM) with a resolution of 2.1 cm per pixel. The mean error, calculated against ground control points recorded using a high-precision multi-band GNSS RTK receiver (Emlid RS3), was 0.005 cm.

Analytical workflow

The combination of archaeological data with APSFR information enables the mapping of the vulnerability of the known archaeological record to river flooding along the Guadiana. To produce this map, a greyscale hillshade generated from the MDT02 and the river network layer from the BTN100 – both downloaded from the Download Centre – was used as the base. The hillshade was created using the default settings of the ArcMap 10.8 software (Azimuth 315, Altitude 45). On this base, the polygons corresponding to the APSFR return periods – T10, T100 and T500 – were overlaid using a colour gradient ranging from

⁸ <https://dataspace.copernicus.eu/explore-data/data-collections/sentinel-data/sentinel-2>

yellow to red. Finally, the polygon layer of archaeological sites provided by the Junta de Extremadura was superimposed with 25% transparency.

For the reconstruction and analysis of the topographic evolution of the La Tabla de las Cañas site, we employed LiDAR data from the PNOA, expropriation plans provided by the CHG and data obtained from our UAV survey.

The workflow used to generate contour lines from the LiDAR data for representing the site's topography was as follows: first, the data were downloaded in .laz format (compressed .las files) and processed using the 'blast2dem' tool from LAsTools, considering only ground points and applying the maximum resolution permitted by each of the downloaded raster datasets. Contour lines were then generated at 2-metre intervals using the appropriate tool in ArcGIS ArcMap 10.8.

In the case of the expropriation plans for the construction of the La Serena reservoir, the original map – available as an image file – was first digitised into a format compatible with the GIS environment used (ArcGIS ArcMap 10.8). The image was then georeferenced, and its contour lines were manually traced, a process which inevitably introduced a certain degree of error. These contours, derived from the CHG expropriation plans, provide a basis for reconstructing the site's topography prior to its submersion beneath the reservoir. As the original plans featured contour intervals at 2 metres, this interval was adopted as the standard unit in the present study – hence why both the UAV and LiDAR-derived results reflect contour lines at two-metre intervals only.

Following the next submersion-emergence cycle, and given the availability of extremely high-quality models such as those provided by LiDAR surveys, the most effective approach for studying erosion is to create Digital Terrain Models (DTMs) before and after the hillfort's inundation, using datasets with identical resolution. The proposed methodology involves generating two comparable raster models and subtracting one from the other. This process will produce a high-resolution map highlighting areas of erosion and sediment deposition, while also allowing for the quantification of the intensity of these processes.

Finally, with regard to pedestrian survey, a Trimble R10-2 GNSS system was used for both the necropolises and the settlement. In the case of the settlement, surface-visible structures were mapped. For the necropolises attributed to the LIA, bone and/or ceramic assemblages were georeferenced, while in the third necropolis – assigned to the EIA – both the bone assemblages and the *encachados* were georeferenced.

Results

Flood risk to archaeological heritage

The heritage data used in this section, provided by the Directorate-General for Libraries, Archives and Cultural Heritage, pertain to the municipalities of Villanueva de la Serena, Don Benito and Medellín (Figure 5a). Within this approximately 25 km stretch – only partially covered by archaeological mapping – up to 15 sites have been identified as vulnerable to potential flooding events along the Guadiana River. Two of these sites are located directly along the river course, and three more fall within the T10 flood risk zone. These five sites are, a priori, considered to be at the highest risk. A further seven sites are situated within the T100 zone, and an additional three within T500. In cases where an archaeological site is affected by multiple return period zones, the classification corresponding to the highest level of risk to its preservation has been used (Figure 5b, Figure 6).

In terms of chronology, the majority of the affected sites date to the Roman period (8), followed by those from the modern and contemporary era (6). Additionally, one prehistoric site, one Iron Age site, one medieval site and one example of industrial archaeology have been recorded. It is important to note that some of these sites are multi-phase and exhibit occupation across more than one historical period (Figure 7).

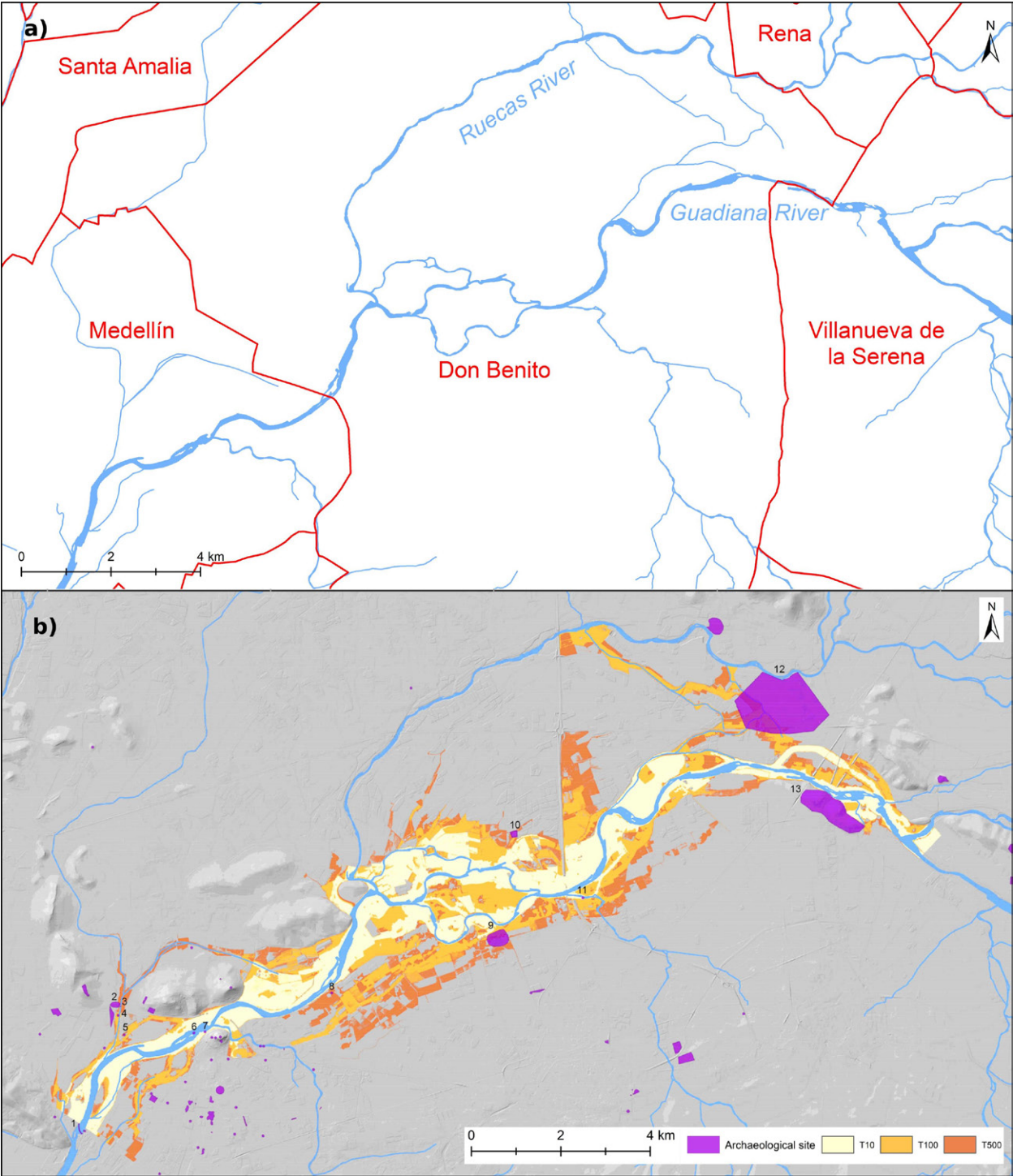


Figure 5. a) Study area, and b) map of archaeological heritage affected by potential flood risk in the Middle Guadiana River Basin: 1) Salto de Sánchez Polo, 2) Archaeological site west of Cagánchez, 3) Puente Cagánchez, 4) Roman villa 1 and 2, gas pipeline, 5) Gámez House, 6) 17th-century bridge of Medellín, 7) Lozano mill, 8) Vegas de Martell, 9) Don Llorente, 10) La Majona, 11) Aceña mill, 12) La Habilla and 13) La Barca-Ventorillo.

Figure 6. Archaeological sites affected by different APSFR return period zones.

	River	T10	T100	T500
No. of sites	2	3	7	3

Figure 7. Chronological classification of archaeological sites affected by APSFR return period zones.

Chronology	Return period zone	No. of sites
Industrial archaeology	River	1
Modern–Contemporary	River	1
	T10	2
	T100	2
	T500	1
Medieval	T100	1
Roman	T10	1
	T100	5
	T500	2
Iron Age	T10	1
Prehistory	T100	1

In short, the integration of archaeological data with APSFR information has enabled the rapid and effective mapping of site vulnerability in relation to the return period zones associated with periodic flood events along the Guadiana River.

Archaeological exposure and erosion processes at La Tabla de las Cañas

A comparison between the contour lines recorded prior to the construction of the reservoir and the most recent data reveals clear evidence of loss of soil within the hillfort. At the 340-metre contour (Figure 8a), the degradation is noticeable but not particularly severe, with the eastern sector of the site showing the most significant impact. In contrast, this loss is far more pronounced at the 342-metre (Figure 8b) and 344-metre (Figure 8c) contours. In the latter case, the eastern portion of the settlement has, in fact, disappeared entirely.

On the other hand, when comparing the results from the second and third LiDAR coverage datasets provided by the PNOA with our own UAV survey, we observe an almost perfect overlap (Figure 9). This outcome was expected, as the water level did not rise to submerge the hillfort between the collection dates of the second and third LiDAR datasets and the UAV flight.

In the case of Necropolis A (Figures 9a and 9b), there is no doubt that the reservoir caused the cremation burial remains to become exposed. A comparison between the LiDAR-based and CHG-derived contour lines shows, for instance, that the highest point at the northern limit of the burial zone now reaches 350 metres, compared to 352 metres on the expropriation plan. A similar pattern is observed in Necropolis B (Figures 9c and 9d), although this area has been less affected by the reservoir than Necropolis A, which explains the lower number of recorded concentrations.

A similar situation is observed in Necropolis C (Figures 9e and 9f), where erosion has once again resulted in a reduction of the maximum elevation. In this case, the northern edge of the necropolis area has declined from 336 metres – recorded prior to the reservoir’s construction – to 334 metres, according to the 2023 dataset from the third PNOA LiDAR coverage.

Finally, taking advantage of the natural exposure of a large portion of the settlement’s structures, it was decided to georeference them using two complementary methods. In the case of the photogrammetric flight, its high resolution allowed for the direct digitisation of structures within a GIS environment (Figure 10). Existing vegetation, including several trees, as well as minor data acquisition errors in some sectors of the hillfort, rendered certain structures undetectable. Conversely, other features were identified through photogrammetry that had not been visible during the pedestrian survey.

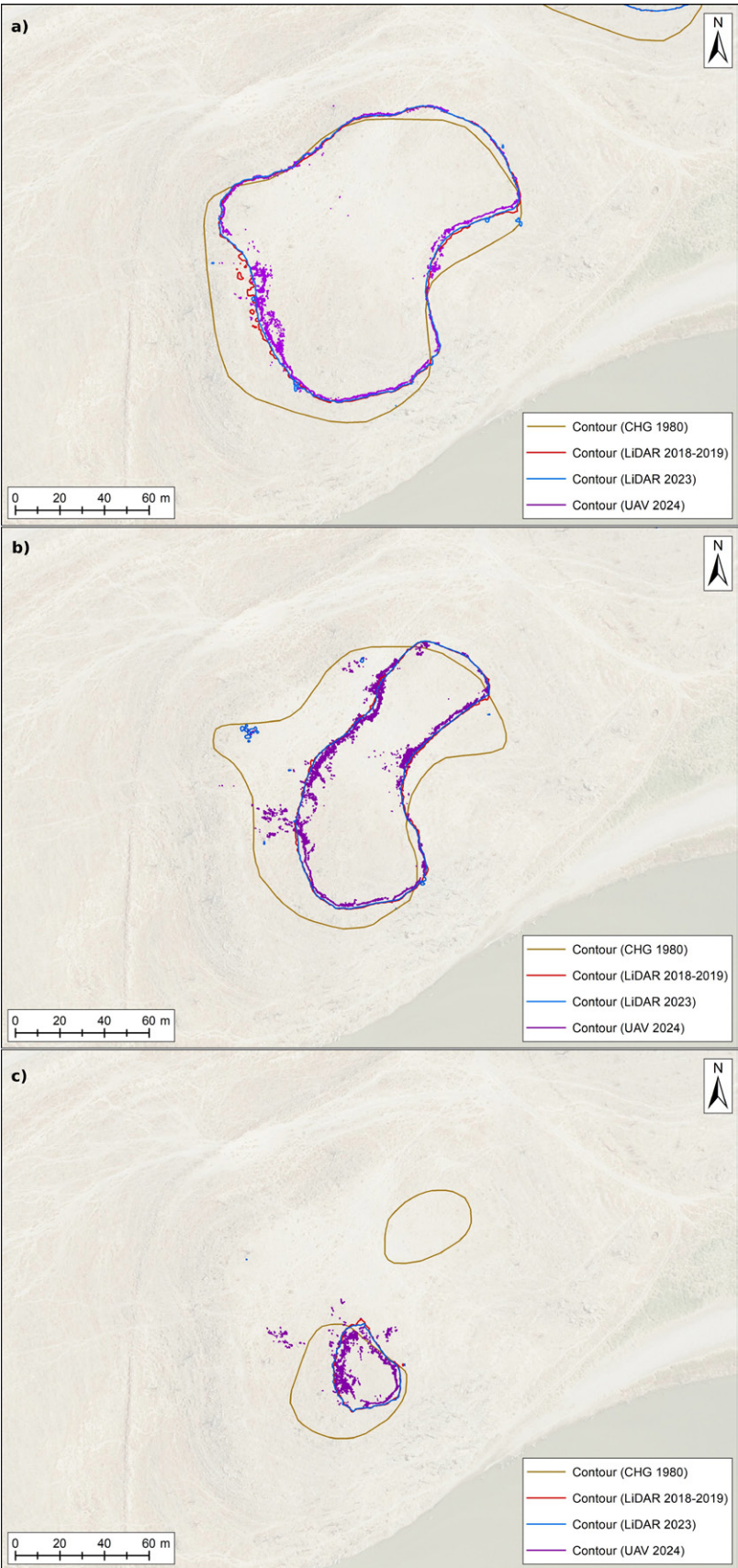


Figure 8. a) Evolution of the 340-metre contour within the hillfort, b) evolution of the 342-metre contour within the hillfort and c) evolution of the 344-metre contour within the hillfort. Base: Most recent PNOA orthophoto.

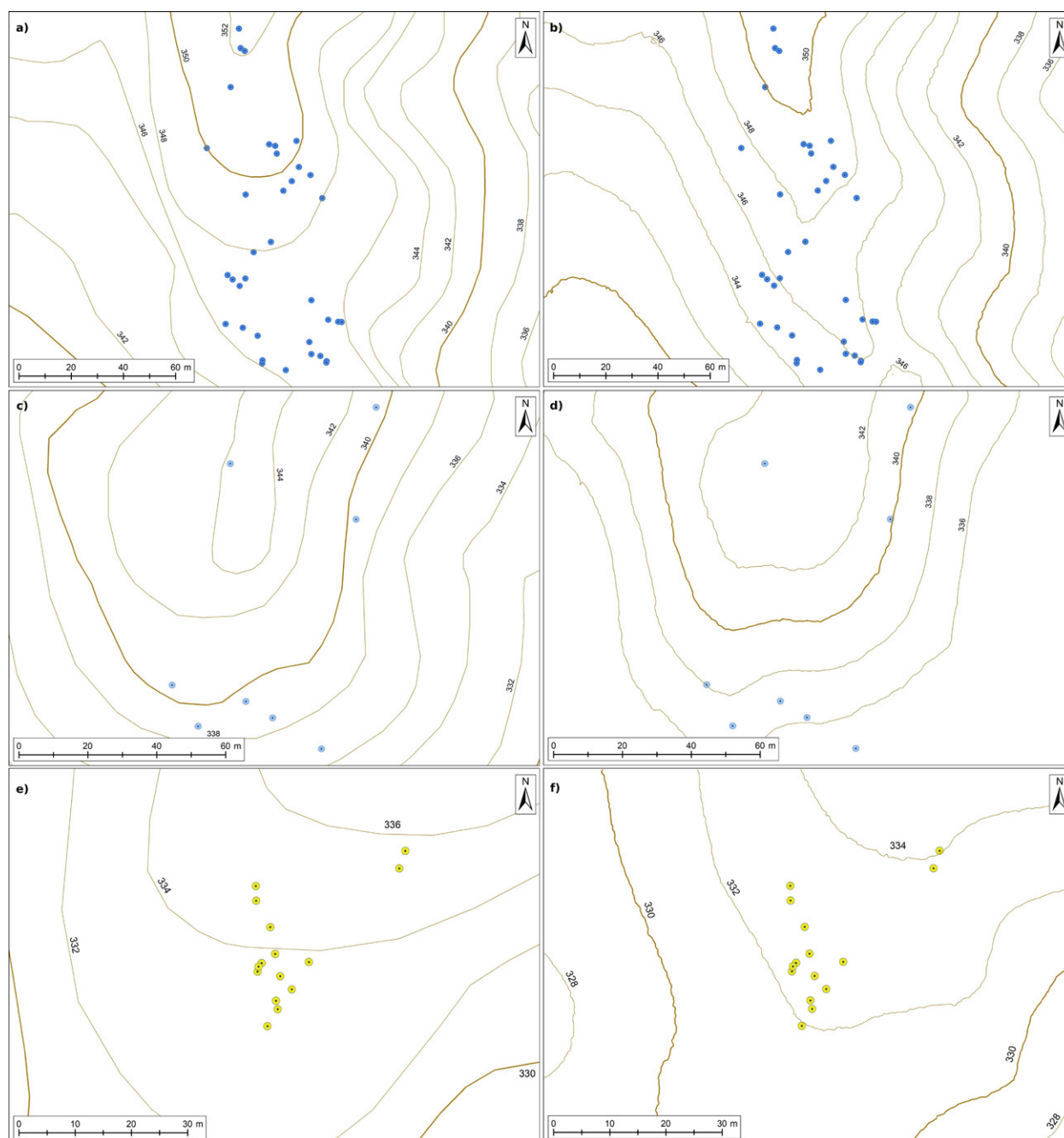


Figure 9. Evolution of the topography of the necropolises at La Tabla de las Cañas. Necropolis A: a) contour lines based on CHG expropriation plan and b) contour lines derived from the model generated using third PNOA LiDAR coverage. Necropolis B: c) contour lines based on CHG expropriation plan and d) contour lines derived from the model generated using third PNOA LiDAR coverage. Necropolis C: e) contour lines based on CHG expropriation plan and f) contour lines derived from the model generated using third PNOA LiDAR coverage.

Pedestrian survey is a slower method, as it involves meticulous data collection in the field followed by post-processing within a GIS environment – a process that takes as much time, if not more, than photogrammetric processing. However, this approach offers key advantages, as it enables the study of spatial relationships between structures. Furthermore, as noted earlier, vegetation is less of a limiting factor for identifying archaeological features during pedestrian survey than in UAV-based imaging.

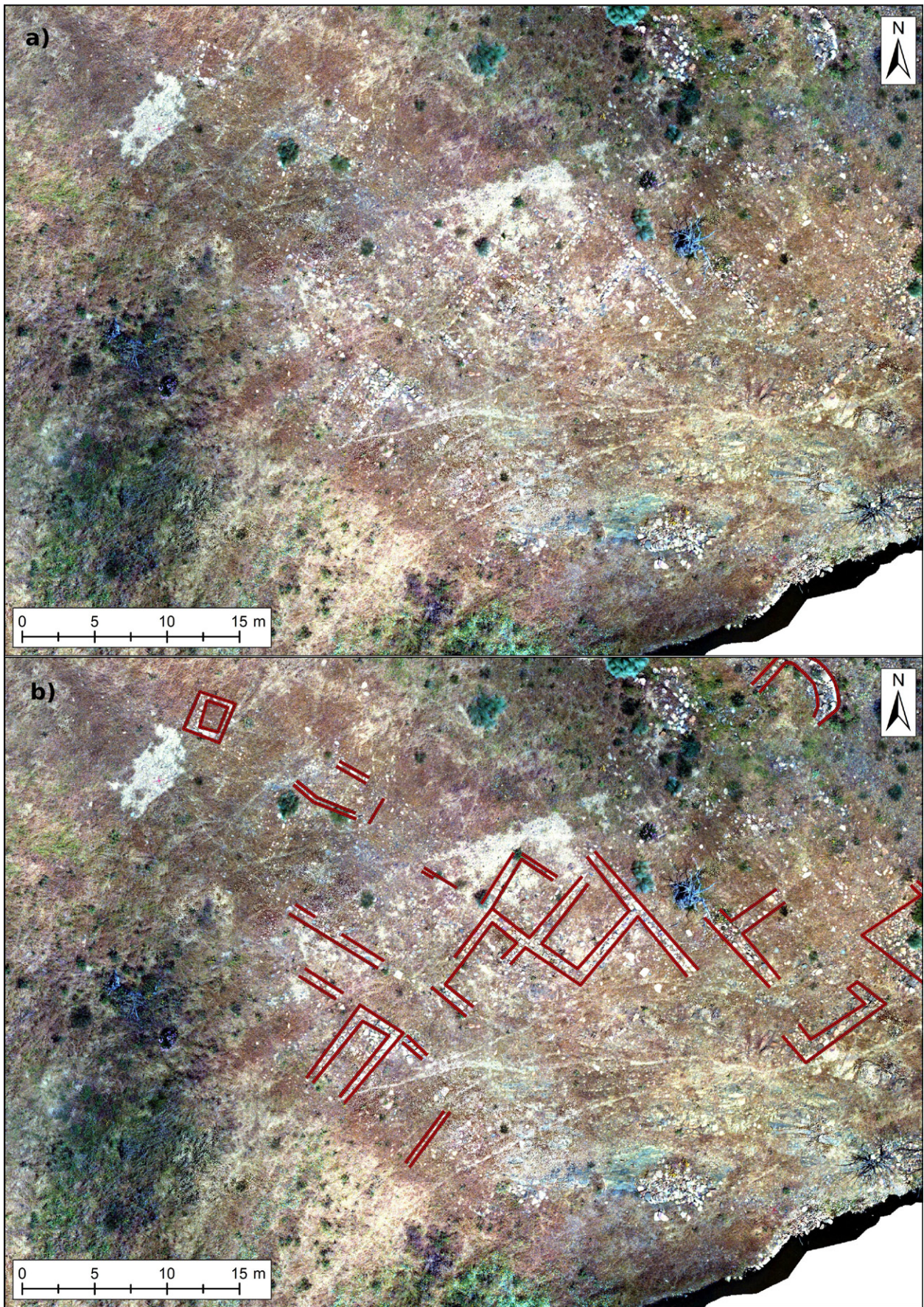


Figure 10. a) Photogrammetric flight over the interior of the hillfort and b) photogrammetric flight over the interior of the hillfort highlighting the structures.

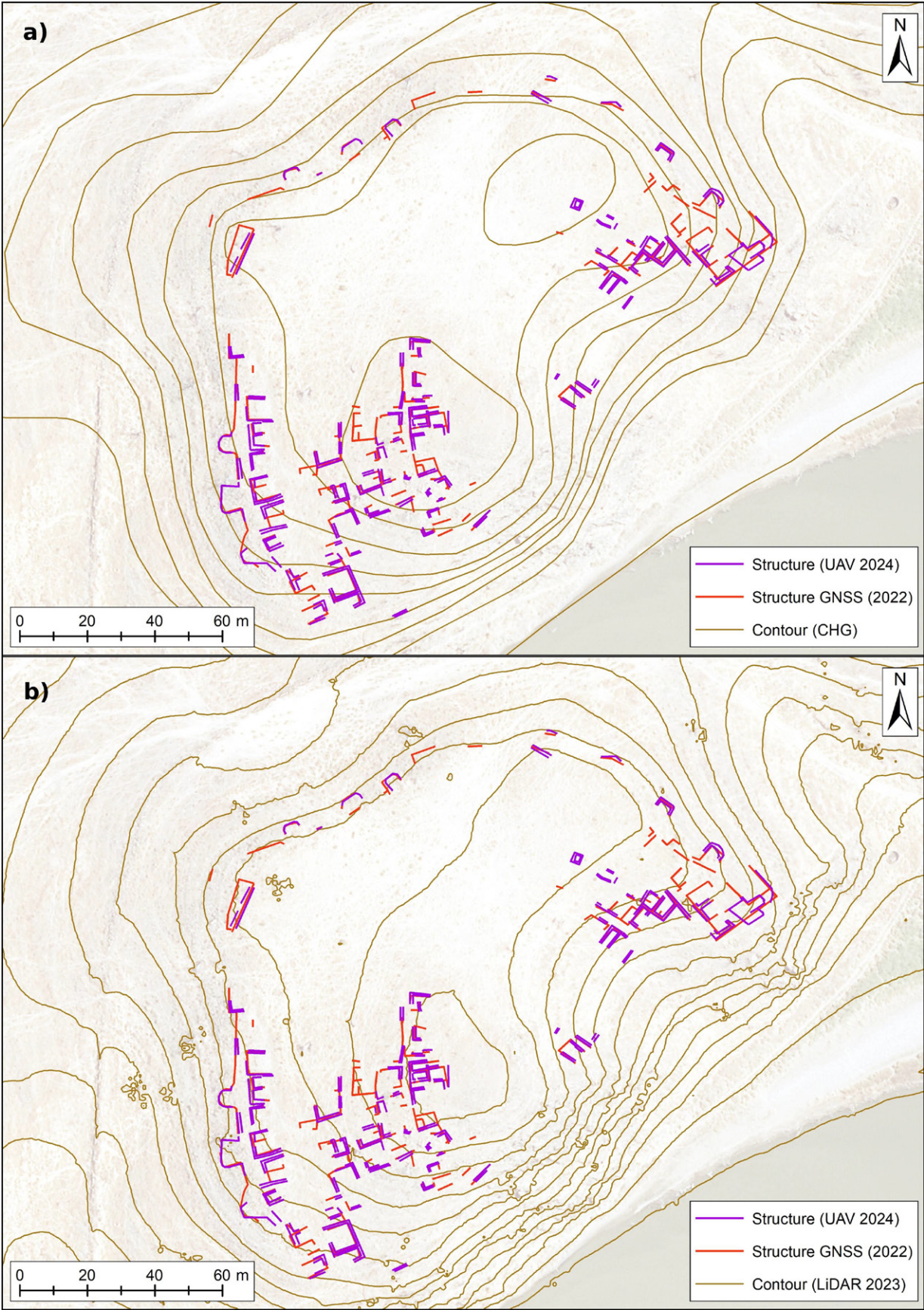


Figure 11. Comparison of documented structures in the hillfort of La Tabla de las Cañas, based on UAV data (2024) and GNSS survey (2022): a) contour lines based on CHG expropriation plan and b) contour lines based on 2023 LiDAR data. Base: Most recent PNOA orthophoto.

As shown in the results (Figure 11), the perimeter wall does not fully conform to the site's topography. In terms of urban layout, several streets can be identified, organising the internal space of the hillfort into small blocks. In the south-western corner – the most exposed area – a possible perimeter path between the internal structures and the wall has been documented, along with small open spaces between buildings. These suggest that, at least in this area, structures were not typically built contiguously. Moreover, the narrow alleys may have functioned as drainage channels. In the north-eastern sector, a singular, large-scale structure stands out from the rest, with a floor plan markedly different from those of other known pre-Roman buildings in the middle Guadiana basin.

Discussion

One of the main utilities of the flood risk impact map for archaeological heritage is its capacity to assess the level of risk for each site on an individual basis. It enables the estimation of how probably a given site may be potentially affected by flood events – every 10, 100 or 500 years. Based on this information, different levels of priority can be assigned for preventive and safeguarding interventions, providing heritage authorities with data to implement corrective or mitigation measures aimed at minimising damage, as well as preparing special action plans (Deguilly 2006; Díez-Herrero 2019).

A more comprehensive and in-depth study – one that takes into account the geomorphological hazards associated with flooding (Díez-Herrero 2019) and how such events affect heritage according to its chronology – would allow for a more nuanced identification of the most at-risk sites. For instance, prehistoric archaeological remains are not affected in the same way as medieval ones. It is therefore possible that a site located within the T100 zone may be more vulnerable than one in the T10 zone, depending on its intrinsic characteristics and surrounding context.

It is also important to highlight that the study area lacks systematic, full-coverage archaeological surveys aimed at completing the regional archaeological inventory. Moreover, not all known sites are currently included in the inventory, for a variety of reasons. Under these circumstances, a second key application of the flood risk impact maps for archaeological heritage is their use in identifying priority zones for site discovery. These maps can guide intensive survey efforts in areas where undocumented archaeological sites are at high risk of flood-related impact.

One of the main limitations of this risk map lies in the origin of the data. As previously noted, the archaeological inventory maintained by the Junta de Extremadura lacks systematic coverage and presents significant gaps in research. A paradigmatic example is our case study at the La Serena reservoir, where the necropolises were previously unknown and lacked any form of protection, although an emergency excavation report existed for one of them (Ortega 1999); however, the site was not georeferenced in the archaeological inventory. Using the resulting map without acknowledging these limitations could lead to a false sense of security when implementing protective measures for heritage assets. Given this constraint, it seems more appropriate – as already suggested – to use existing knowledge of flood-prone areas as a basis for designing site detection strategies, assigning higher priority to zones that are potentially more vulnerable.

Another limitation relates to the origin of the APSFR data. The monitored element is the Guadiana River, meaning that studies have not yet been conducted for its tributaries, such as the Zújar. As a result, some sites located near the currently mapped areas could in fact be affected by flooding from these tributaries. Likewise, certain sites identified as being within the T100 or T500 return period zones may actually be at risk from more frequent flood events – such as those associated with T10 or T100 zones – once data from the tributaries become available.

Focusing on La Tabla de las Cañas, the combined use of LiDAR data, our own UAV survey and pedestrian fieldwork has made it possible to trace the site's topographic evolution and document surface-visible remains, offering insights into the internal layout of the hillfort and the spatial arrangement of the necropolises.

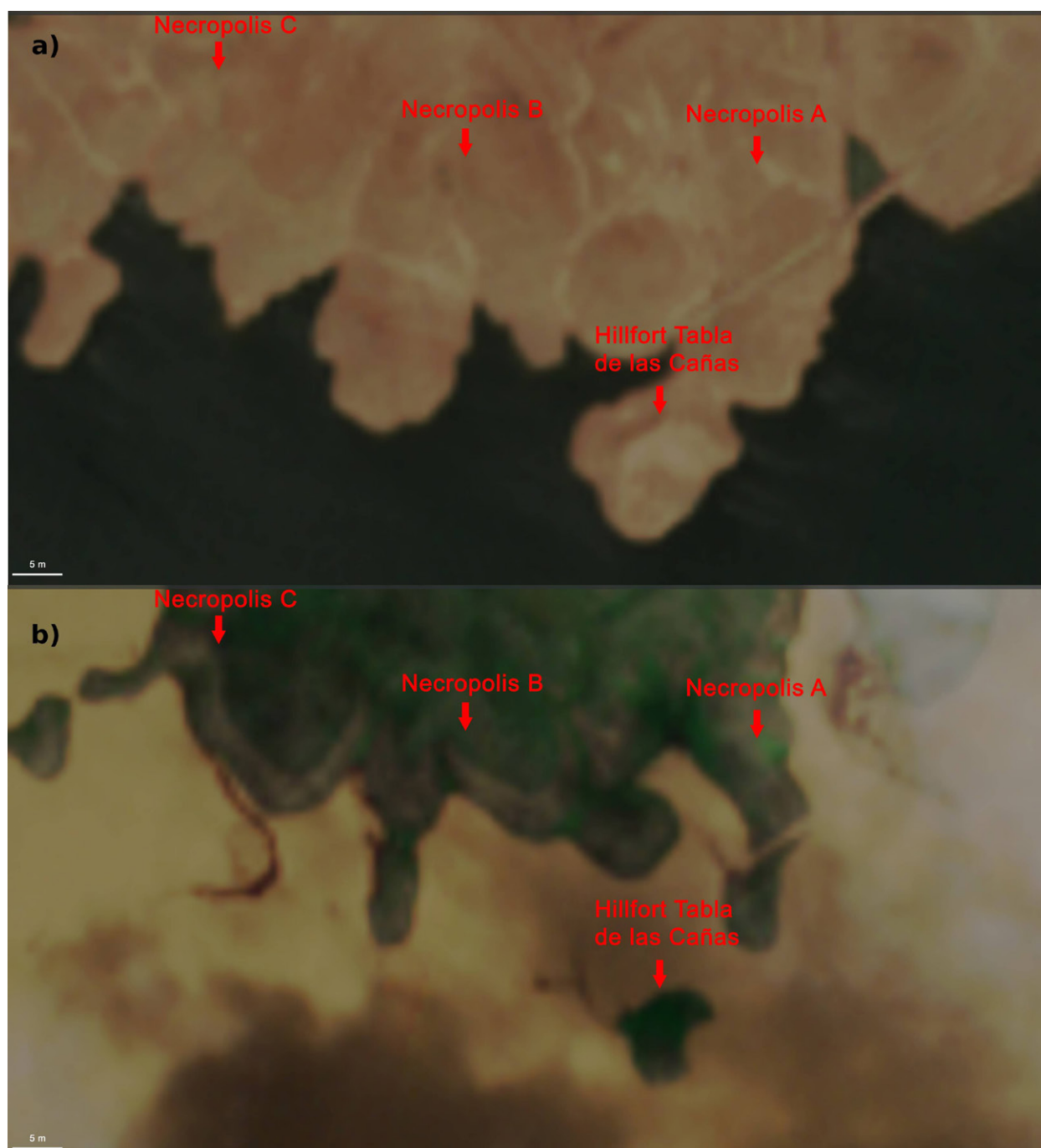


Figure 12. Comparison of water levels in the La Serena reservoir: a) Copernicus Sentinel imagery, 23 August 2024; b) Copernicus Sentinel imagery, 23 March 2025.

Regarding the hillfort's topography, it is evident that the reservoir has progressively eroded the site, particularly in the south-western and north-eastern sectors of the settlement. Monitoring this erosion should be considered a priority for implementing corrective and preventive conservation measures, including emergency interventions in the areas recently exposed by the reservoir.

The comparison between the different data collection methods confirms the high level of accuracy achieved by the UAV survey, whose model closely aligns with the LiDAR data provided by PNOA. The main limitation of the UAV method lies in the presence of vegetation, which affects both the visibility of archaeological remains and the accurate recording of ground points.

A comparison of the most recent datasets does not reveal any significant changes in the site's topography, likely due to the absence of major water level fluctuations that might have affected the site. However, as water levels have already begun to rise during the first quarter of 2025 – now surrounding the archaeological remains at La Tabla de las Cañas, as shown in the Copernicus Sentinel imagery (Figure 12) – the work already undertaken offers a unique opportunity to assess the impact of the reservoir on submerged archaeological heritage.

Regarding the study of the urban layout, a partial understanding has been achieved thanks to the remains exposed by the reservoir's erosive action. Excavation data confirm that the visible structures – characterised by the use of large stone blocks – correspond to the Roman Republican phase. Several streets and alleys have been documented, along with the remains of various buildings. However, the absence of further excavation prevents a definitive interpretation of their function. Among these structures, one located in the north-eastern corner of the site stands out due to its clearly foreign typology, which can likely be associated with the Roman presence. As for the wall, the presence of both semicircular and rectangular bastions has been confirmed, and at least for this later phase, there appears to have been a walkway running between the inner structures and the wall.

Finally, the erosion caused by the reservoir has not only revealed two previously unknown necropolises but has also allowed for the identification of two distinct burial types. One is characterised by the presence of *encachados*, while the other is defined by cremation urns. In the latter case, no clear spatial arrangement of the urns has been observed; they are often placed directly on the bedrock itself, which in some instances appears to have been worked. In these areas, the reservoir's erosion has led to a loss of up to two metres in stratigraphic depth in certain areas and has significantly altered the site's topography.

Conclusions

In this context, the case of La Tabla de las Cañas stands as a valuable example of how episodic exposure caused by fluctuating water levels can offer both risk and opportunity. While the erosive processes threaten the integrity of the archaeological record, they also make previously inaccessible or undocumented features available for study. The challenge lies in developing proactive and adaptive strategies capable of responding to these changes in a timely manner. Integrating high-resolution spatial data, such as UAV imagery and LiDAR, with archaeological observation allows for the implementation of monitoring protocols that can be activated whenever sites re-emerge. These tools not only enhance documentation efforts but also support the prioritisation of emergency interventions.

Ultimately, this study underscores the need for a broader, cross-institutional commitment to the identification, documentation and protection of flood-prone and submerged archaeological heritage. Given the increasing unpredictability of hydrological regimes in the context of climate change, the integration of Geographic Information Technologies into heritage management is not only useful – it is essential. While the results presented here are part of an ongoing research effort, they contribute to building a methodological and analytical foundation for future work, both in Extremadura and in similar hydrological and archaeological contexts across the Iberian Peninsula and beyond.

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Tanners and leatherworkers in ancient Iberian society (6th–2nd centuries BC). A social approach to production

Pablo S. Harding-Vera¹

Abstract

This paper studies the evidence of leather production in ancient Iberia and the identity and social position of those who practiced related crafts: tanning and leatherworking. All surviving tools used in leather production are compiled and provide evidence for the existence of a developed and specialised sphere of production requiring specialised tools. The evidence can mostly be dated to the 4th century BC. The study of the contexts and material assemblages in which they were discovered suggests that this craft was largely carried out within the domestic sphere by members of the household. It also points to the existence of a group of specialised leatherworkers whose remains were buried with signs of their rank such as expensive weaponry and toilet implements. This group of Iberian leatherworkers strikes a contrast to the disdained workers described by Classical authors.

Key words: Iberian Peninsula, Middle Iberian Period, leather production, tools, society

Résumé

Cet article étudie les preuves de la production de cuir dans l'Ibérie ancienne ainsi que l'identité et le statut social de ceux qui pratiquaient les métiers associés : le tannage et la maroquinerie. L'ensemble des outils subsistants utilisés pour la production de cuir a été compilé, témoignant de l'existence d'une sphère de production développée et spécialisée nécessitant un outillage spécifique. Les données chronologiques se rapportent principalement au IV^e siècle av. J.-C. L'étude des contextes et des assemblages matériels dans lesquels ces outils ont été découverts suggère que cet artisanat était largement pratiqué au sein de la sphère domestique par les membres du foyer. Elle souligne également l'existence d'un groupe de travailleurs du cuir spécialisés dont les restes ont été inhumés avec des marques de leur rang, telles que des armes de prix et des instruments de toilette. Ce groupe de travailleurs du cuir ibériques offre un contraste saisissant avec l'image méprisée décrite par les auteurs classiques.

Mots-clés: Péninsule Ibérique, Ibérique Plein, production de cuir, outils, société

Introduction

In recent years, researchers studying the Mediterranean Iron Age have increasingly begun to analyse the social dimension of craft production. Prominent lines include exploration of the mechanisms through which knowledge is spread both within and between communities and individual craft workers (Brysaert 2007, 2008; McGovern 1989), but also the role and status of craft workers in society (Costin 1998). The discovery of structures and tools in spaces that can be linked to aristocratic elites and their clients, such as wealthier residences and particularly funerary contexts, has led to authors questioning traditionally held views, influenced by aristocratic Classical sources, that trace a clear distinction between the higher echelons of Iron Age society and craft activities (Gorgues 2017). This is particularly true in the case of tools used in woodworking or crafts involving precious metals deposited in funerary contexts (Graells 2007; Iaia 2006). Overall, this line of study can provide valuable nuances for understanding the nature of craft production, its perception in society, as well as its use and particular place in the construction of political and social ties.

The study of the social dimension of production among the Iberian peoples (6th–2nd centuries BC) has mostly focused on the production of prestige goods and structures used by the Iberian elites, and its control by the latter. For example: the control of silverwork in the *oppidum* of La Bastida de les Alcusses (Moixent, València) (Pérez Jordá *et al.* 2011; Vives-Ferrándiz 2013, 2022), the creation and consumption of Iberian painted vessels (*see* Vizcaíno 2015), the identification of possible itinerant silversmiths crafting

¹ Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid; pabloharding@outlook.com

decorated iron swords (Quesada *et al.* 2000) or even the highly elaborate stonework of Iberian monuments (see Robles 2024).

This paper seeks to contribute to this general discussion through a distinct case study: that of tanning and leatherworking in Iberian culture. Due to a general absence of preserved leather, leather production has received very little treatment in research on the Iberian peoples, although many specialised tools used in leather production have been preserved in well-documented contexts. Furthermore, that many of these contexts are commonly understood as contexts linked to Iberian elites, *oppida* (hillfort settlements) and necropoleis, allows for reviewing modern understanding of tanners and leatherworkers, still heavily influenced by the disdain transmitted by Greek and Roman writers (Dercy 2015: 187–199; Leguilloux 2004: 13–15, 60–65). Two objectives structure the following pages: firstly, the cataloguing and classification of all tools used in leather production in the Iberian world, a necessary and valuable step that allows for understanding the degree of specialisation of the craft overall and its insertion into other facets of Iberian production cycles. Secondly, the social organisation of leatherworking, as can be reconstructed, and the status and role of evidence of Iberian leatherworkers. Preceding this body of evidence, however, is a discussion on the methodology and concepts guiding this study.

Leather production and archaeology

Throughout this paper, leather production is conceived as a ‘production cycle’. This term is understood as defined by T. Mannoni and E. Giannichedda (2007) in their seminal work on the Archaeology of Production. Thus, a production cycle consists in the series of processes and actions necessary to turn a natural resource found readily in nature, into a product that can be consumed by human societies. The necessary processes can be understood as following the logic of the *chaîne opératoire*, that is, the actions must follow a specific order that cannot be altered. Often, the production cycle can result in ‘subproducts’ and ‘waste’, which depending on the case, can also be reused, although in leather production this is less frequent. Production cycles often interlink with one another in a myriad of different ways, whether this be by providing necessary materials, rendered from natural resources, or the implicit production processes necessary for the tools used in said production. Leather production itself includes two different processes with their own specialised artisans: tanning and leatherworking.

Tanning consists in the process by which animal skins are rendered into leather, which is simply the resilient part of animal tissue, comparatively imputrescible and durable. This can be achieved by means of drying, curing with smoke or fat, soaking in mineral baths – tawing – and tanning with vegetable tannins (Reed 1972: 46–48; Van Driel-Murray 2008: 483). The process is well understood by researchers (Leguilloux 2004: annex, table 1; Reed 1972: 46–85; Van Driel-Murray 2008: table. 19.1), and goes through three distinct stages that, depending on time and place, may include more or less procedures. Starting with a flayed skin, the first stage is the preparation of the hide: it is trimmed to the measure of the tanner, soaked to remove excess dirt and further unhaired and sometimes fleshed, in which all excess tissue such as fat and hair is removed via different aqueous solutions and physically scraped away with an unhairing knife. The second stage is the tanning itself, in which the skin is immersed in progressively stronger liquid solutions containing tannins, which may be of animal, vegetable or mineral origin. The earlier methods consisted in the application of animal lipids to the hides, while the immersion in mineral agents, called tawing, originated in the Middle Ages. Once tanned, the hides were then dried, often by simply being hung in the tannery itself, in a process that lasted at least two weeks in documented traditional tanning (Castellote 1987: 180; Leguilloux 2004: annex, table 1). The third stage includes the series of finishing processes, following R. Reed: this includes currying, in which the leather is smoothed with oils, dyeing or spraying, to provide gloss finishes. The overall process may last between 25 and 27 days in summer, and between 42 and 44 days in winter (Castellote 1997: 180; Leguilloux 2004: annex, table 1). Tanning production varies widely in scale: many traditional tanners are family businesses, as they were in the Middle Ages, while Roman leather production, in contrast, is known to have reached a truly massive scale, with large corporations or *collegia* of tanners even becoming political forces unto themselves (Leguilloux 2004: 15–16; Van Driel-Murray 2008: 490).

Leatherworking, by contrast, is the process by which the leather is given shape and turned into the wide array of products used by human communities. It includes various professions, mainly named after their area of expertise, some being more or less specific to certain geographic regions: shoemakers, wineskin makers (*botores* in Spanish), saddlers, etc. For the leatherworker, the physical-chemical characteristics of the leather are essential, and preferences vary depending on the task and craft in question. Tanners recognise and respond to this necessity, and in smaller-scale productions will acquire and tan specific skins when requested by known leatherworkers, or directly tan skins acquired by interested leatherworkers (Fernández de Gamboa 1979: 27). I. Hamilton-Head (1979: 9–11) provides an overview of the utility of different types of leather, be it due to the animal, or to the way in which they were tanned. For example, leather from a calf is far better than sheep leather in general, and Hamilton-Head (1979: 10) actively discourages the use of the latter for modern practitioners. Furthermore, oak bark tanned leather is more suited for shoes due to its hard finish, while vegetable tanned leather is suitable for tooling due to its supple natural finish and is the leather type most often used by craftsmen. The adequacy of the leather to the task and its overall quality will also depend on the part of the hide to which it belongs: for example, the back and the butt of a cowhide are the best pieces of the hide. Wineskin makers provide a last extreme example: these craftsmen require skins with hair still attached, which eases the application of pitch to the insides. The wineskin makers interviewed by Castellote (1987: 181) use goatskins specifically, and much prefer winter coats, as in summer the goats shed their hair, and this worsens the quality of the leather. The work carried out by the different professions is mainly carried out by a single person from beginning to end, which explains in part how most leatherworkers work alone or accompanied only by their apprenticed descendants, learning the family trade (Castellote 1987: 176–177). In the Roman era, shoemakers joined together in corporations, *collegia*, being one of the oldest alongside tanners themselves (Leguilloux 2004: 63). Nevertheless, the material evidence of leatherworkers does not include highly visible and identifiable structures as in the case of tanners and their tanneries.

These two processes are intimately linked, just as they are also dependent on other production cycles. For example, the hunters, herders and livestock owners who provide the skins themselves; the traders who transport and sell the skins to the tanneries themselves and the leathers to the leatherworkers; lime production, specialised gatherers, and butchers, all of which provide materials necessary for the tanning process. Leatherworkers often work in tandem with other craftsmen, especially carpenters. It is essential to remember that no craft exists in a vacuum, even as, for convenience, it is studied as such.

Archaeological studies of leather production are marked by the survival or not of leather itself. Thus, regions in which leather and cured hides have been more frequently discovered are those in which conditions are very dry, such as Egypt and parts of the Middle East, or sufficiently humid for anaerobic contexts that facilitate preservation of organic matter, such as the European northwest: in the Mediterranean region, preservation is more difficult (Van Driel-Murray 2008: 484). Nevertheless, inorganic remains of this production do exist: buildings, structures and various types of tools. Examples of this are the few tanneries Roman tanneries identified thus far in Pompeii (Italy) and Vitodurum (Switzerland) (Leguilloux 2004: 44–50; Van Driel-Murray 2008: fig. 19.2). Comparisons with traditional leather production known through ethnographic sources can help to fill the gaps of the archaeological record, but only to a certain extent. Many of the structures and tools have, indeed, not changed significantly since the Second Iron Age, as suggested by depictions of shoemakers found in Attic pottery and steles or Roman gravestones (Dercy 2015: fig. 6–7; Reddé 1978: fig. 4), markedly similar to traditional leatherworking tools (Castellote 1987: 178, 182). But ethnographic evidence must be used with caution, despite its usefulness, as certain processes typical of traditional leather production, such as liming or bating (Reed 1972: table 1) were unknown before the 14th century AD (Van Driel-Murray 2008).

Archaeologically known leather was either cured or tanned with vegetable extracts (Van Driel-Murray 2008: 485). Curing involved smoking or rubbing oils or fats into the hide, sometimes both, as described in a memorable passage of the *Illiad* (17.389–93). Vegetable tanned leather is closely linked to the Roman conquest, as pointed out by C. van Driel-Murray (2008: 487); prior to Roman presence, vegetable tanned leather was unknown in regions as diverse as the northwestern provinces of Europe or even Egypt.

Vegetable tanning is traced back to the 5th century BC, following the commentaries on plant properties of certain Greek authors (Van Driel-Murray 2008: 487); however, as written sources do not comment on the leather of other cultures inhabiting the Mediterranean coasts, and examples of leather are scarce or, as in the Iberian case, non-existent, current research is unable to attest to other Mediterranean culture knowing of vegetable-tanning processes. Therefore, when certain tools such as unhairing knives are discovered, archaeologists can point to them as evidence of the processing of hides, without being able to distinguish between tanning and curing.

The written sources are generally unspecific on the details of ancient leather production itself. Relevant information is mostly gleaned through secondary references made by authors such as Aristotle, Theophrastus, or Pliny the Elder (Van Driel-Murray 2008: 487). These sources are, however, useful for understanding the social organisation and status of tanners and leatherworkers in society. Both gathered in the corporations, or *collegia*, being in fact some of the oldest. Tanners were held in particularly low regard due to the smell of the products, which motivated locating the tanneries in Rome downriver following the Tiber, as well as the unskilled nature of much of the work, often carried out by slaves (Leguilloux 2004: 15). Leatherworkers could be perceived both in a negative and positive light; the former is largely due to their existence as craftsmen who work with their hands, the latter when seen as specialised workers creating necessary goods such as shoes (Dercy 2015: 193–197; Leguilloux 2004: 62–66). Even when disdained, however, leatherworkers were not seen to be as lowly as tanners. Nevertheless, overall, comparisons with Greek but particularly Roman leather production must recognise that this production was transformed from small-scale craftwork to a veritable industry. C. van Driel-Murray (2001: 58) points out that in nonurban areas leather working was traditionally a female activity, transformed into a male, controlled, and centralised industry employing large numbers of slaves. Thus, when examining Iron Age communities like those in Iberia, it must be understood that the role and perception of tanners and leatherworkers transmitted by authors inhabiting Greek poleis or aristocrats in imperial Rome is highly contextual. It serves, nevertheless, as a useful point of comparison.

Working tools and their contexts: notes on method

Tools used in leather production have not changed significantly over time, which facilitates the process of their identification. It also poses a problem when the tools are extracted from their archaeological context, as there may be little distinguishing Iberian, Roman or Medieval examples of a same tool type. Thus, context is key. Furthermore, many of the recurring tools employed in leather production are specific to it, specialised for certain functions: unhairing knives, slickers, lunette knives, awls, punches, cobbler's last, and shoemaker knives. On the other hand, other tools in this paper are more versatile and multifunctional: everyday knives, shears, mallets, or needles. A further complication arises from the design of certain tools, such as unhairing knives, which depending on how the handles were fixed to the blades, could suggest that they were a different tool altogether, in this case, drawknives. In the following pages, when the identification of certain tools can lead to doubt, the necessary contextual information will be provided.

When considering the social aspects of leather production, such as workspaces, the identification of workers and their social standing, it is also crucial to understand the nuances and limitations of the material assemblage. In this paper, the identification of workspaces, a term preferred as workshop implies a degree of spatial specialisation and professionalisation, hinges on the microspatial analysis of the structures and the relationship between different material types. Preference is given to those assemblages identifiable as results of a 'primary deposition', composed of materials discovered at their location(s) of use or where discarded as primary refuse, which are key for studying the main uses of each space, even as considerable care must be taken when analysing mobile objects, such as tools (LaMotta and Schiffer 1999: 21–22). This is mostly applicable to assemblages within settlements.

Tools discovered in funerary assemblages can sometimes be considered to have been created as offerings and not have been used as tools at all. This debate affects interpretations of the social standing of the

deceased, which is treated below with more length. For the graves included here, however, the tools can be understood to have been functional in design. In some cases, due to their scarce value, both symbolic and economic, as occurs with the awls in Graves 131, 204 or 209 of El Cigarralejo (Mula, Murcia). In other cases, because the tools constitute ‘functional associations’; that is, they all belong to the specific toolkit of a certain craft and would have been used together by the same person. Thus, the iron tools must first be read as everyday items rendered ritual by their inclusion in funerary assemblages, before considering the specific symbolic connotations.

Leather production in the Iberian world

That leather was a widely used material among the Iron Age Iberian peoples is not doubted. In an agricultural society, leather was essential for creating a wide array of products, the mere variety of which can be seen in B. Dercy’s (2015: 59–159) meticulous cataloguing of all types of leather objects mentioned in Classical Greek written sources. Iberian uses for leather can be, and have been, seen at the very least in its iconographic depictions: sheathes, bags, baldrics, shoes, helmets, and even shields (Blech and Ruano 1998; Quesada 2023). These objects are as markedly aristocratic as Iberian iconography itself, concerned with aristocratic ideals of war, hunting, horses, and ceremonies. The reality of leather objects would have been far greater, and considerably more prosaic.

To date, no tanneries have been discovered. Many reasons can be considered for this. For one, the excavation of settlements has not been carried out to an equal degree throughout the entire Iberian world: regions such as the southeast and south lag behind the east and northeast. Secondly, settlement excavations scarcely go beyond the city walls, where tanneries are often located, due to an understandable desire to focus on the urban plan itself, or simply because the often difficult topography of the fortified hillforts and *oppida* simply did not allow for any more structures to be built. Nevertheless, vats, tanks, and presses, as are frequently required for tanning processes, have been documented in Iberian territories, although they were mostly used for processing wine and oil, sometimes within aristocratic houses themselves (Mata *et al.* 2007: 137).

This lack of evidence, however, works on the premise of Iberian tanneries using only vats and tanks instead of other liquid containers, such as re-used ceramic containers. This specific practice is well-documented in a case of textile-dyeing in 1st century BC *Libisosa* (Albacete) (Uroz Rodríguez 2022: fig. 37d). Furthermore, Iberian tanneries may well have been located far beyond the walls of the hillforts and *oppida* due to the need for water sources, thus setting up close to rivers, below the fortified heights of the *oppida*. In this sense, a study on wine and oil production in the territory of Kelin, in the modern province of Valencia, revealed a markedly dispersed production landscape: wine and oil presses carved into rocks close to the fields themselves, located between smaller, rural farmsteads (Mata *et al.* 2007).

The lack of tanneries also means that any animal remains that could be linked to the tanneries are also absent (see Leguilloux 2004: 56–60). Nevertheless, animal remains in Iberian *oppida* include species preferred by traditional leatherworkers: sheep, goat, cow, and pig (Fernández de Gamboa 1979; Hamilton-Head 1979: 4–9; Maicas Ramos and Huertas Viciano 1986: 87–97; Castellote 1987: 181–185). For example, in La Bastida de les Alcusses (Moixent, Valencia), one of the sites with a greater concentration of leatherworking tools, bones belonging to goat and sheep are the most frequent, followed by bovines; weight estimates place bovines as the most important, followed by again goats and sheep (Pérez Jordá *et al.* 2011: figs. 21 and 22). It is therefore by no means risky to assume that most leather would have been made from these animal species.

The workplaces of leatherworkers such as shoemakers, saddlers and the like are more difficult to identify than tanneries, due to the general lack of specific structures. These workplaces are usually identified by the presence of the tools of the trade, and there are a few cases in the Iberian world that can fit this description, particularly in the Iberian *oppida* of La Bastida de les Alcusses (Moixent, Valencia), and are treated below.

Thus, the most important evidence of leather production in the Iberian world are the metal tools, exclusively made from iron. As mentioned beforehand, these include tools that are well-known to be the specific implements of tanners and leatherworkers, such as unhairing knives or lunette knives, as well as other less specialised tools that accompanied them, such as shears.

Tools used in Iberian leather production

Tools from seven sites have been identified as being used in leather production. The sites stretch the entire breadth of Iberian territory, from the Iberian northeast to the Valley of the River Guadalquivir. Five of the sites are settlements, and the remaining two include a necropolis and a sanctuary.

The settlements range from large, fortified settlements that would have controlled their respective territories, called *oppida* – such as Los Villares (Caudete de las Fuentes, Valencia), La Bastida de les Alcusses (Moixent, Valencia), or Cerro de la Cruz (Almedinilla, Cordoba) –, smaller fortified *oppida* – La

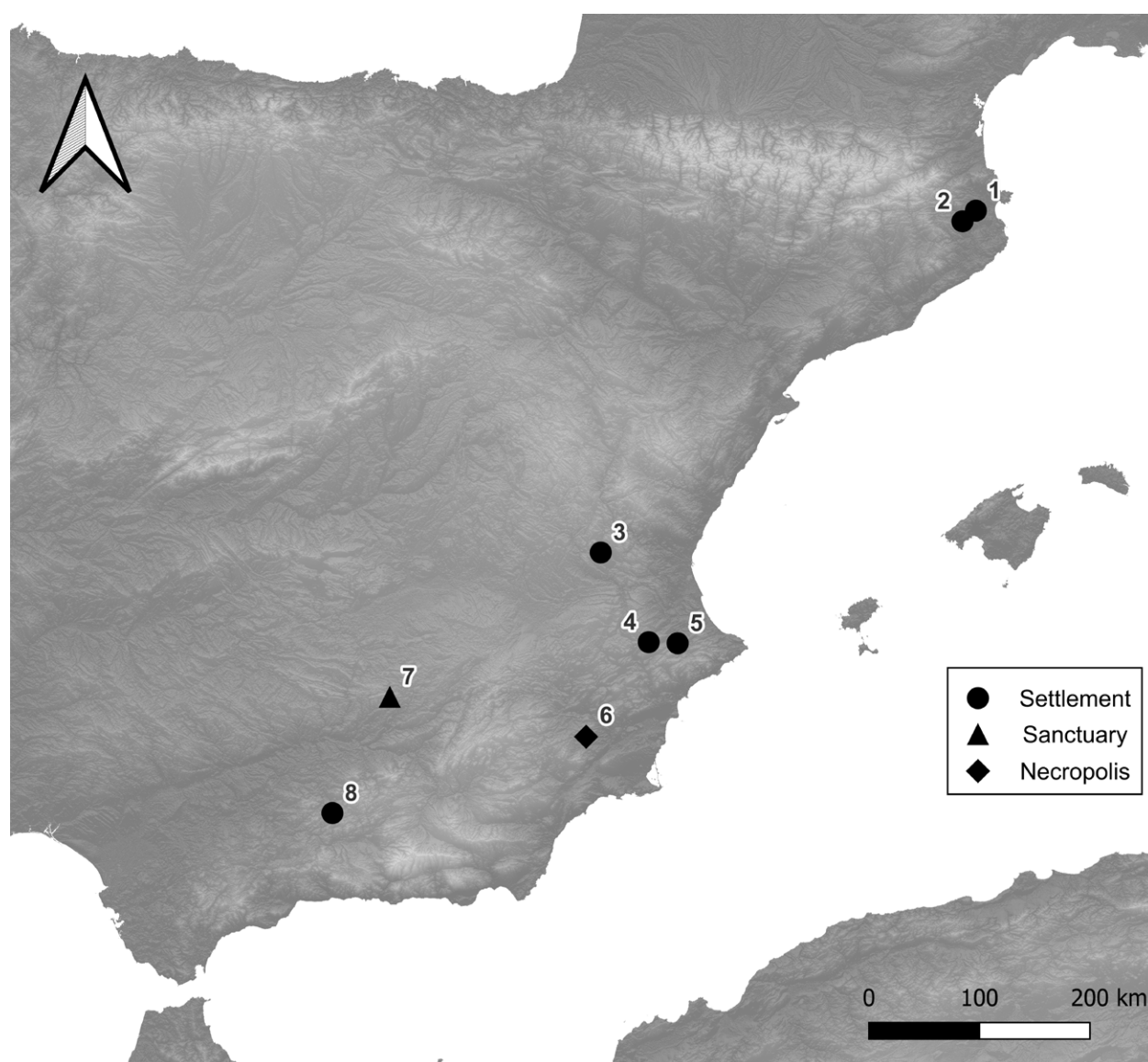


Figure 1. Locations of the sites mentioned in the text. 1. Mas Castellar (Pontós, Girona); 2. Porqueres (Banyoles, Girona); 3. Los Villares (Caudete de las Fuentes, Valencia); 4. La Bastida de les Alcusses (Moixent, Valencia); 5. La Covalta (Albaida, Valencia); 6. El Cigarralejo (Mula, Murcia); 7. Collado de los Jardines (Santa Elena, Jaén), 6. Cerro de la Cruz (Almedinilla, Córdoba).

Covalta (Albaida, Valencia) – and lastly, specialised rural establishments, as in the case of Mas Castellar (Pontós, Girona). This last example is a special case, marked by its proximity to the Greek colonies of *Emporion* and *Rhode*, which it supplied with agricultural produce, as shown by the large number of silos; in its later phase, the inhabitants of Mas Castellar abandoned the small fortified *oppidum* and occupied an unfortified settlement dedicated to cereal production (Pons *et al.* 2010).

The *oppida* all share a series of features: they are fortified settlements that occupied high locations with good visibility of the surrounding landscape, which varied depending on the surrounding geography, and were generally long-lived: materials date their origins to the 7th and 6th centuries BC, and their ends in the 2nd and 1st centuries BC. The only exception is La Bastida de les Alcusses, a new settlement built at the start of the 4th century and abruptly destroyed in its second half, which greatly favoured the preservation of materials, especially the large number of iron tools that set it apart from most Iberian settlements (Bonet and Vives-Ferrándiz 2011b: 254–255). Another destroyed settlement is Cerro de la Cruz, this time in the context of the Lusitanian Wars of the mid-2nd century BC (Quesada 2020–2021).

The last two sites include the necropolis of El Cigarralejo (Mula, Murcia), and the sanctuary of Collado de los Jardines (Santa Elena, Jaen). The necropolis of El Cigarralejo is the best-known part of a larger site that also includes an excavated sanctuary at the top of the hill also called ‘El Cigarralejo’ and the unexcavated settlement occupying large part of the hillside. The necropolis occupied a short stretch of land in which the more than 500 graves often overlay one another. It was in use between the 5th and 1st centuries BC, although the 4th century is by far the most important, including approximately 80% of the total (Cuadrado 1987; Graells and Pérez Blasco 2022: 31–39). For its part, Collado de los Jardines is an important sanctuary erected in and around a cave system located next to and overlooking the Pass of Despeñaperros that connects the Valley of the Guadalquivir River and the Meseta to the north. Its rise has been linked to the territorial expansion of the city of Castulo (Linares, Jen), and its use is considered to have begun in the 4th century BC, although its excavation at the start of the 20th century makes more precise dating difficult. It is best known for its bronze offerings, in the shape of humans but also animals, objects and even organs; together with more everyday offerings, they were deposited in the cave and in pits located close by (Rueda and Bellón 2016: 51–53).

Overall, these sites provide a catalogue of 83 tools used for leather production. The distribution is by no means equal: 88% of the total comes from just two sites, the *oppidum* of La Bastida de les Alcusses and the necropolis of El Cigarralejo. This is largely due to the nature of their meticulous, long-lasting, and extensive excavation, as well as the very nature of the sites: the rapid destruction of La Bastida de les Alcusses and the funerary nature of the graves of El Cigarralejo both favour the preservation of the tools. This unequal distribution also means, however, that the catalogue as a whole is skewed towards the 4th century BC, the Middle Iberian period, and a specific region, the Iberian southeast.

An attempt has been made to gather the specific chronology and place of discovery of each specimen, although in some cases only a general date is available, and for others no further information regarding location is provided beyond the site itself.

The most frequent tool type by far is the awl, constituting almost 60% of the total, followed by lunette knives, unhairing knives, shears, and less frequent specimens such as three shoemaker’s knives and two ‘saddler’ knives. What follows is a discussion of the specific tool types, starting with the specialised tools of the tanner and leatherworker, and then the less specific tool types, such as shears.

Unhairing knives

The unhairing knife is the tool used by the tanner to scrape away at the hair side of the skin in the *unhairing* stage, clean away any remains of tissue on the flesh side of the skin in the *fleshing* stage, and even remove other traces of dirt in the *scudding* stage (Reed 1972: 53). The three actions could most likely be carried out in quick succession by the tanner. Unhairing knives are held two-handed and used

SITE	Context	Chron. Context	Cat. Nº	Tool	Reference
Mas Castellar de Pontos (MC)	House 1	225-175	MC-1	Awl	Rovira 2002: 352, fig. 11.19.8
	House 2	225-175	MC-2	Awl	Rovira 2002: 352, fig. 11.23.13
Porqueres (PO)	Unknown	300-200	PO-1	Saddler knife	Sanahuja 1971: 68, fig. 25.1
			PO-2	Saddler knife	Sanahuja 1971: 68, fig. 25.2
Los Villares (LV)	Room 20	600-500	LV-1	Lunette Knife	Mata 2019: 71, fig. 4.8, 0365-2
	Forge, House 2	400-175	LV-2	Lunette Knife	Mata 2019: 122, fig. 4.46, 0148-1
	Room 2	400-175	LV-3	Awl	Pla 1968: fig. 40
La Covalta (CO)	Unknown	400-300	CO-1	Lunette Knife	Pla 1968: fig. 35.4
	Building 17, Room 2	400-325	BA-1	Awl	Fletcher, Pla and Alcacer 1965: 34, nº 28
	Building 17, Room 3	400-325	BA-2	Lunette Knife	Fletcher, Pla and Alcacer 1965: 43, nº 24
	Building 17, Room 4	400-325	BA-3	Shears	Fletcher, Pla and Alcacer 1965: 46, nº 7
	Building 8, Room 15	400-325	BA-4	Awl	Fletcher, Pla and Alcacer 1965: 88, nº 8
	Building 9, Room 37	400-325	BA-5	Awl	Fletcher, Pla and Alcacer 1965: 185, nº 21
			BA-6	Awl	10
	Building 10, Room 38/39	400-325	BA-7	Awl	Fletcher, Pla and Alcacer 1965: 193, nº 9
	Building 10, Room 49	400-325	BA-8	Awl	Fletcher, Pla and Alcacer 1965: 242, nº 30
	Building 10, Room 52	400-325	BA-9	Awl	Fletcher, Pla and Alcacer 1969: 16, nº 4
			BA-10	Awl	Fletcher, Pla and Alcacer 1969: 16, nº 6
	Building 10, Room 55	400-325	BA-11	Awl	Fletcher, Pla and Alcacer 1969: 24, nº 2
			BA-12	Awl	Fletcher, Pla and Alcacer 1969: 24, nº 3
	Building 10, Room 58	400-325	BA-13	Awl	Fletcher, Pla and Alcacer 1969: 36, nº 22
			BA-14	Awl	Fletcher, Pla and Alcacer 1969: 36, nº 24
	Building 10, Room 59	400-325	BA-15	Awl	Fletcher, Pla and Alcacer 1969: 42, nº 14
	Building 5, Room 61	400-325	BA-16	Awl	Fletcher, Pla and Alcacer 1969: 53, nº 4
	Building 5, Room 63	400-325	BA-17	Awl	Fletcher, Pla and Alcacer 1969: 63, nº 11
			BA-18	Shears	Fletcher, Pla and Alcacer 1969: 130, nº 7
	Building 5, Room 64	400-325	BA-19	Awl	Fletcher, Pla and Alcacer 1965: 69, nº 14
	Building 10, Room 66	400-325	BA-20	Awl	Fletcher, Pla and Alcacer 1965: 84, nº 33
	Building 11, Room 71	400-325	BA-21	Awl	Fletcher, Pla y Alcacer 1969: 130, nº 7
			BA-22	Awl	Fletcher, Pla and Alcacer 1969: 160, nº 51
La Bastida de les Alcusses (BA)	Building 11, Room 75	400-325	BA-23	Awl	Fletcher, Pla and Alcacer 1969: 160, nº 52
			BA-24	Esparto needle	Fletcher, Pla y Alcacer 1969: 162, nº 71
	Building 11, Room 78	400-325	BA-25	Awl	Fletcher, Pla y Alcacer 1969: 172, nº 23
			BA-26	Awl	Fletcher, Pla y Alcacer 1969: 172, nº 24
	Building 11, Room 80	400-325	BA-27	Lunette Knife	Fletcher, Pla and Alcacer 1969: 189, nº 37
			BA-28	Awl	Fletcher, Pla and Alcacer 1969: 187, nº 26
			BA-29	Awl	Fletcher, Pla and Alcacer 1969: 187, nº 27
	Building 20, Room 83	400-325	BA-30	Awl	Fletcher, Pla and Alcacer 1969: 199, nº 7
	Building 20, Room 84/85	400-325	BA-31	Awl	Fletcher, Pla and Alcacer 1969: 208, nº 25
			BA-32	Awl	Fletcher, Pla and Alcacer 1969: 259, nº 59
	Building 15, Room 96	400-325	BA-33	Awl	Fletcher, Pla and Alcacer 1969: 259, nº 60
			BA-34	Awl	Fletcher, Pla and Alcacer 1969: 300, nº 86
	Room 99	400-325	BA-35	Awl	Fletcher, Pla and Alcacer 1969: 300, nº 88
			BA-36	Awl	Fletcher, Pla and Alcacer 1969: 325, nº 231
	Room 100	400-325	BA-37	Awl	Fletcher, Pla and Alcacer 1969: 325, nº 232
			BA-38	Awl	Fletcher, Pla and Alcacer 1969: 325, nº 233
	Building 7, Room 126	400-325	BA-39	Unhairing knife	Pla 1968: fig. 19.1
			BA-40	Shoemaker knife	Pla 1968: fig. 36.2
	Unknown	400-325	BA-41	Shoemaker knife	Pla 1968: fig. 36.1
			BA-42	Shoemaker knife	Pla 1968: fig. 36.3
			BA-43	Saddler knife	Pla 1968: fig. 37.2
			BA-44	Lunette Knife	Pla 1968: fig. 35.2
	Grave 20	375-325	CIG-1	Lunette Knife	Cuadrado 1987: 121, nº 176
			CIG-2	Shears	Cuadrado 1987: 121, nº 179
	Grave 131	375-300	CIG-3	Awl	Cuadrado 1987: 280, nº 1182
			CIG-4	Lunette Knife	Cuadrado 1987: 323, nº 1598
			CIG-5	Awl	Cuadrado 1987: 323, nº 1604/1
			CIG-6	Awl	Cuadrado 1987: 323, nº 1604/2
	Grave 161	400-375	CIG-7	Awl	Cuadrado 1987: 323, nº 1604/3
			CIG-8	Shears	Cuadrado 1987: 323, nº 1605
	Grave 204	375-350	CIG-9	Awl	Cuadrado 1987: 377, nº 1797
			CIG-10	Awl	Cuadrado 1987: 387, nº 1924/1
	Grave 209	400-375	CIG-11	Awl	Cuadrado 1987: 387, nº 1924/2
			CIG-12	Awl	Cuadrado 1987: 387, nº 1924/3
	Grave 243	375-350	CIG-13	Lunette Knife	Cuadrado 1987: 437, nº 2295
			CIG-14	Lunette Knife	Cuadrado 1987: 492, nº 2832
El Cigarralejo (CIG)	Grave 283	300-200	CIG-15	Awl	Cuadrado 1987: 492, nº 2843
			CIG-16	Unhairing knife	Cuadrado 1987: 547, nº 3536
			CIG-17	Unhairing knife	Cuadrado 1987: 547, nº 3538
			CIG-18	Unhairing knife	Cuadrado 1987: 547, nº 3538bis/1
			CIG-19	Unhairing knife	Cuadrado 1987: 547, nº 3538bis/2
			CIG-20	Saddler knife	Cuadrado 1987: 547, nº 3539bis
			CIG-21	Awl	Cuadrado 1987: 547, nº 3531A
			CIG-22	Awl	Cuadrado 1987: 547, nº 3531B
			CIG-23	Awl	Cuadrado 1987: 547, nº 3531
			CIG-24	Unhairing knife	De Prada and Cuadrado 2019: 68, nº 4463
			CIG-25	Unhairing knife	De Prada and Cuadrado 2019: 68, nº 4464
			CIG-26	Awl	De Prada and Cuadrado 2019: 68, nº 4474/1
			CIG-27	Awl	De Prada and Cuadrado 2019: 68, nº 4475
			CIG-28	Awl	De Prada and Cuadrado 2019: 68, nº 4476
			CIG-29	Awl	De Prada and Cuadrado 2019: 68, nº 4474/2
Collado de los Jardines (CJ)	Unknown	400-100	CJ-1	Lunette Knife	Calvo and Cabré 1917: 41
Cerro de la Cruz (CC)	Room O	200-140	CC-1	Awl	Vaquerizo, Quesada and Murillo 2001: 222, fig. 96.315

Figure 2. List of the tools mentioned in the text.

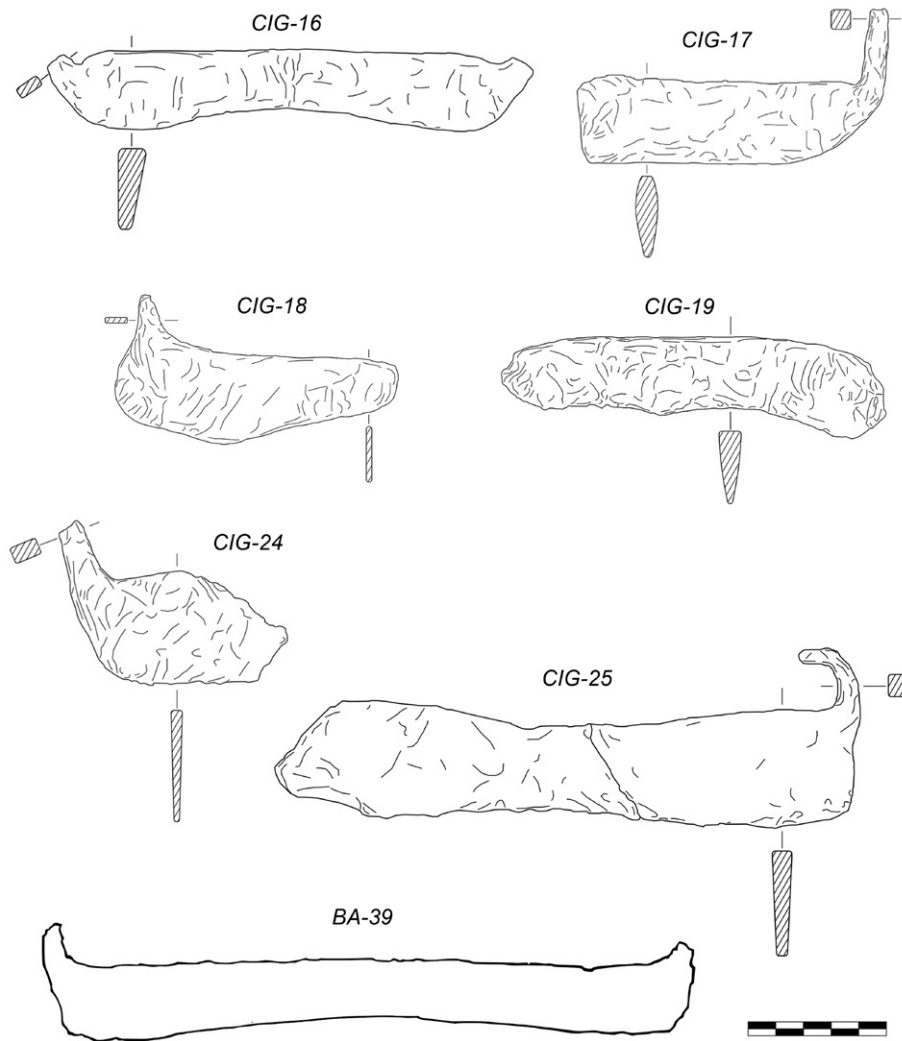


Figure 3. Unhairing knives. From La Bastida de les Alcusses (Moixent, Valencia) – BA – (after Pla 1968); and from El Cigarralejo (Mula, Murcia) – CIG- (by the author).

along with a wooden beam or horse, usually a simple tree trunk, to which the often concave blade of the unhairing knife is adapted.

Seven unhairing knives survive in the Iberian world, six of which were found in two graves from El Cigarralejo, and a seventh specimen in Room 126 of La Bastida de les Alcusses. All share a similar basic structure: a long narrow rectangular blade with an edge on one of the longer sides and two tangs emerging from the opposite side, at each end of the rectangle. All but one – CIG-17 – have concave edges. The tangs can either rise straight from the back of the blade, or at an open angle, and as in the case of one completely preserved tang, end in a sort of hook.

The identification of these unhairing knives is not without its difficulties. Authors have hesitated between considering them unhairing knives used in tanning or as carpenter's drawknives (Pla 1968: 154; Sanahuja 1971: 96; Tortajada 2012: 295–296), due to the similarities between these two-handed tools, and with no clear answer. This is the case of the specimen from Room 126. A third interpretation was provided by W. H. Manning in his study on the iron tools of the British Museum. He considered two smaller specimens, measuring 13.7 and 10.9 cm in length, to be slickers (Manning 1985: 39). Manning doubted that they were

drawknives or spokeshaves, another carpenter's tool, because of the way the tangs are fixed to the blade. For him, it is more logical that the tools were provided with a straight and simple wooden handle and used by pushing rather than drawing the blade towards or away from the body.

Considering these doubts, the identification of these unhairing knives requires justification. Firstly, their identification as slickers can be discarded. Slickers are intended to be blunt instruments used for easily smearing oils and fats into the skin as well as removing superficial impurities (Reed 1972: 65), hence why they have frequently been made of wood or even bone (Van Driel-Murray 2008: fig. 19.2). Furthermore, the description provided by Manning when describing the functions of his slickers are those of an unhairing knife when he says they are used 'to force out and scrape off dirt and other impurities from the tanned hide'. (Manning 1985: 39). The simple wooden handle described by Manning could also have been crafted with space for grasping it with two hands, which may explain the hook on the larger unhairing knife of Grave 431 of El Cigarralejo or the open angle of other specimens, two ways to better fix blades facing downwards. Although two-handled like a drawknife, an unhairing knife is not drawn towards the body, but rather pushed away from it. A further clue for their interpretation as unhairing knives is the concave edge of many of the specimens, adapted to the round surface of the wooden beam.

But the true key to interpreting the six unhairing knives of El Cigarralejo as such, and not as drawknives, are the other tools that accompany them. Graves 333 and 431 contain three and four awls respectively, and Grave 333 also contains a saddler knife. Thus, while the debate surrounding the specimen from Room 126 is still open, the associations with other tools lead to the conclusion that the specimens from El Cigarralejo are, indeed, unhairing knives.

Lunette knives

Lunette knives are a common leatherworker's tool since Antiquity, even appearing in the hands of shoemakers in Greek Red-Figure pottery (Dercy 2015: fig. 6). They are used for cutting leather by working the edge back and forth, as well as skiving, that is, thinning the leather with a very sharp blade (Hamilton-Head 1979: 22–23). As per the name, lunette knives are mostly known for their semi-circular blade, hafted by a tang fixed to the inside of the convex blade. As outlined by Gaitzsch (1980: 123, fig. 13), there is variety within this premise, depending on the width and breadth of the blade, as well as the angle of the tang. 11 Iberian lunette knives are known. There is considerable variety in such a small group, but a first differentiation establishes two main categories depending on how the blades are hafted: tanged, and U-shaped.

There are eight tanged lunette knives, which differ in the specific shape of the blades. The shape of the blade affects how the blade is hafted and therefore how the object is used, therefore it is worth differentiating between the different variants. There are, thus, four subtypes of Iberian lunette knife. The first subtype is characterised by a roughly triangular blade, of varying width, and no marked ridge between blade and tang; this includes five of the eight and is comparable to Gaitzsch's Type E lunette knife. The second subtype is largely similar to the previous subtype but presents a marked ridge between the blade and the tang and is found in the specimen from La Covalta (Albaida, Valencia). The third subtype presents a wide, curved blade like the previous two, differing in the breadth of the semi-circular blade itself, thinned to a minimum expression; the Collado de los Jardines (Jaen) specimen falls into this subtype, comparable to Gaitzsch's Type C lunette knife. And lastly, the fourth subtype is the lunette knife from Grave 20 of El Cigarralejo, which while having a curved edge, has a rectangular body with a pronounced ridge between blade and tang. As a rule, the narrower the edge, the more manageable the tool is when carrying out precise cuts and skiving; the maximum expression of this desire is the specimen from Grave 20 of El Cigarralejo. In contrast, the wider the edge, the more force can be applied when cutting thicker hides. The three remaining lunette knives, of the U-shaped variety, respond to this need in particular.

The identification of U-shaped lunette knives is a recent development, arising from the discovery of the specimen from the Forge at House 2 of Los Villares (Caudete de las Fuentes, Valencia) (Mata 2019: 122,

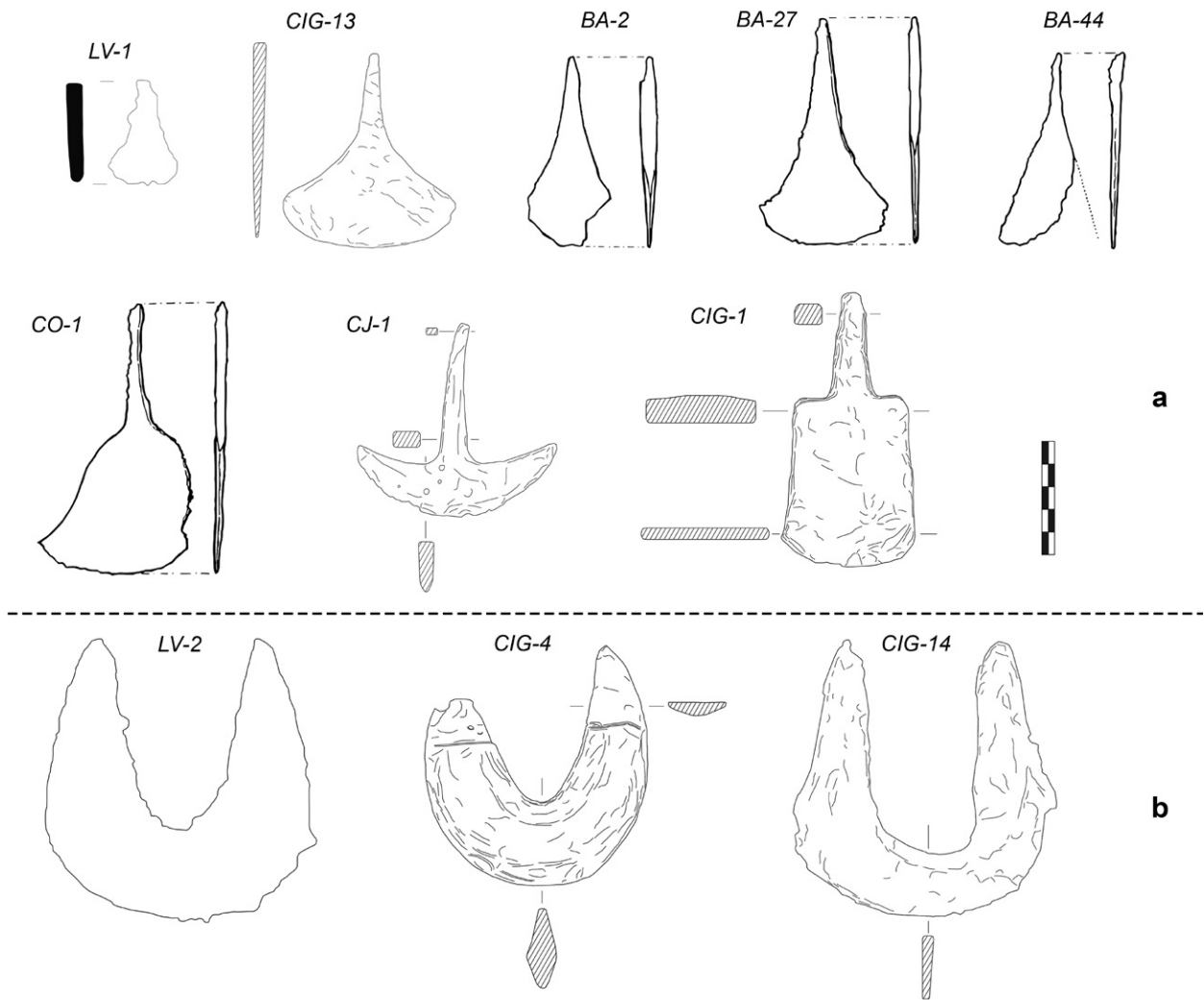


Figure 4. Lunette knives. a) Tanged lunette knives; b) 'U' shaped lunette knives. From Los Villares (Caudete de las Fuentes, Valencia) – LV – (after Mata 2019); from La Bastida de les Alcusses (Moixent, Valencia) – BA – (after Pla 1968); from La Covalta (Albaida, Valencia) – CO – (after Pla 1968); and from El Cigarralejo (Mula, Murcia) – CIG – (CIG-13 after Cuadrado 1987: 437, no. 2295; CIG-1, 4, and 14 by the author); and from Collado de los Jardines (Santa Elena, Jaen) – CJ – (by the author).

fig. 4.46, 0148-1). The team doubted whether the specimen was a type of unhairing knife or a horseshoe, due to its shape. The first option was considered more probable, when an edge was detected, and its effectiveness was seen when an exact replica was created and tested (Mata 2019: 122, note 5). Lastly, the team also conducted a microscopic study of the ends of the 'U', revealing evidence of plant matter, specifically pine, and resin; this was seen as proof of a handle (Mata 2019: 225). This example was then joined by two more from Graves 161 and 283 from El Cigarralejo, as a result of a re-study of the published materials (Harding-Vera 2025) and roughly contemporary in date. Further evidence in favour of linking the three with leather production was the identification of three awls in Grave 161 and another in Grave 283. Nevertheless, although the Los Villares specimen was considered a possible unhairing knife, its function seems closer to that of a lunette knife, albeit somewhat larger. The U-shaped lunette knives would have been hafted by slotting the ends of the 'U' into a handle, allowing for a more powerful cut, albeit less precise, which would be useful in the case of thicker leathers such as cowhide.

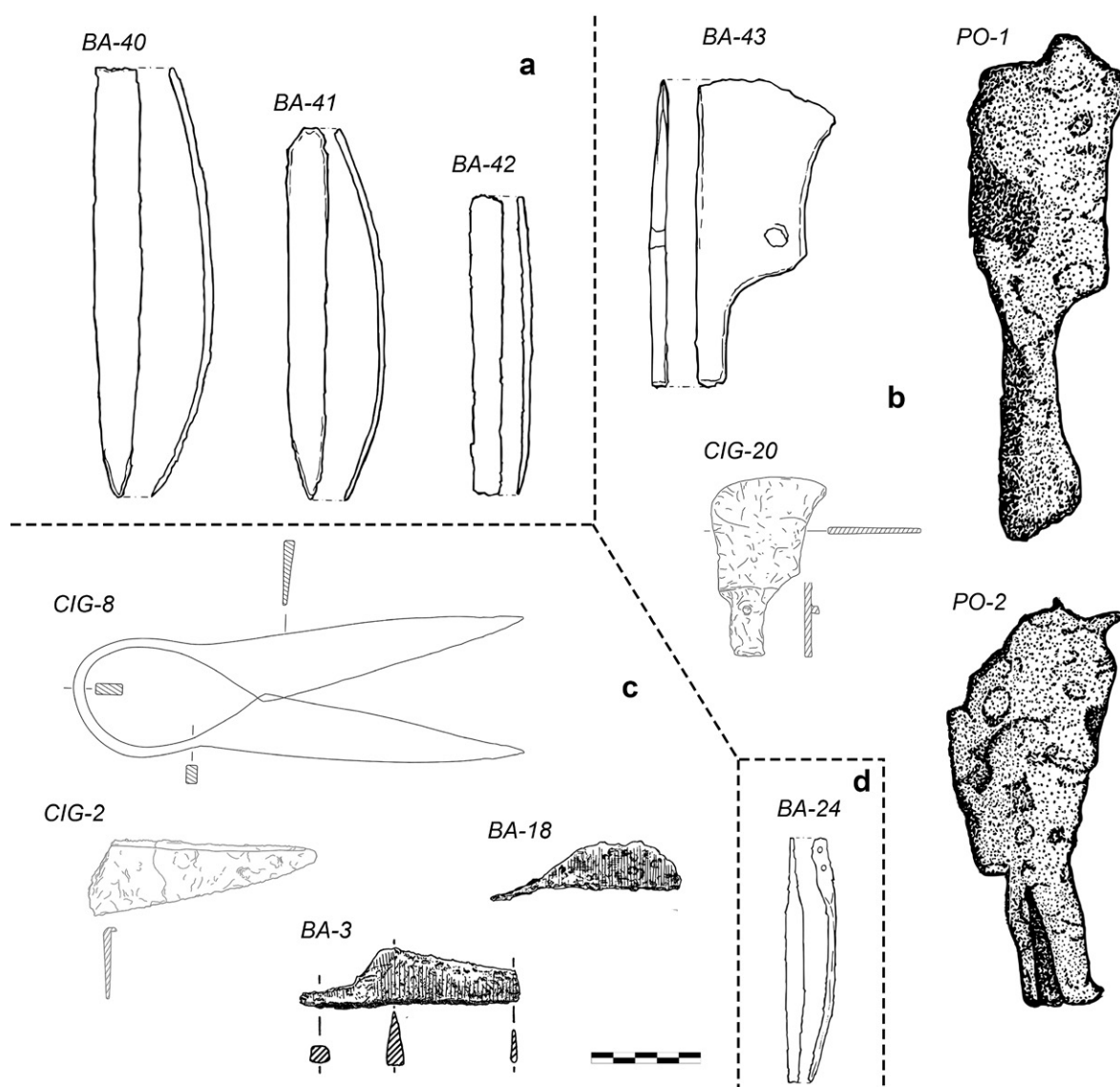


Figure 5. a) Shoemaker knives; b) Saddler knives; c) Shears; d) Esparto needle. From La Bastida de les Alcusses (Moixent, Valencia) – BA – (BA-24, 40, 41, 42 and 43 after Pla 1968; BA-3 and BA-18 after Fletcher *et al.* 1965, 1969); from El Cigarralejo (Mula, Murcia) – CIG – (CIG-8 after Cuadrado 1987: 323, no. 1605; CIG-2 and CIG-20 by the author); and from Porqueres (Banyoles, Girona) – PO – (after Sanahuja 1971).

Shoemaker knives

This name was given by E. Pla (1968: 160, fig. 36) to three pieces found in La Bastide de les Alcusses due to their similarity to similar tools used by shoemakers to cut the tough and thick hides used for the soles of shoes. The three pieces are long, narrow, and rectangular blades with a single sharpened tip. Pla identified two types. Firstly, that of the two longer blades, which ended in sharp triangular tips, and were curved in profile. And secondly, the remaining piece, that lacked the triangular tip and was almost, although not entirely, straight.

Saddler knives

There is a particular type of knife used by traditional Spanish *guarnicioneros*, a profession that includes that of the saddler as well as sorts of leather equipment, called *cuchilla de uña* or nail knife, due to its shape (Maicas and Huertas 1986: 90). In its modern version, it is a short and wide blade, roughly rectangular,

fixed to a handle from one of its shorter sides. One of the far corners of the blade tends to extend to a curved tip, with a curved edged surface descending back towards the handle. It is also common for it to have a sort of hook in the back of the blade itself, located next to the handle. Here the term ‘saddler knife’ is used for the sake of convenience, since it is well-known that Iberians did not have true saddles as such (Quesada 2023: 198) and ‘leather knife’ is too generic.

The Iberian examples (Figure 5) do not have this hook, and the curved edge stretches farther towards the haft, which goes towards explaining the doubts of previous authors who encountered these knives. Prior interpretations noted their use as cutting instruments (Pla 1968: 160; Sanahuja 1971: 100) but did not know for what material. The specimen deposited in Grave 333 of El Cigarralejo provided the key for its identification. It was initially described as a pruning knife (Cuadrado 1987: 547), although this can be disregarded, as it bears no resemblance to Iberian, Roman or even modern pruning instruments (Pla 1968). In Grave 333 it was joined by other tools used in leather production: four unhairing knives and three awls. Furthermore, another piece, with a similar shape to the specimens from El Cigarralejo and Porqueres specifically, was found in the Roman villa of El Saucedo (Toledo). This Roman knife has a short metal handle hafted like a ‘*cuchilla de uña*’ and was in fact interpreted as being used for leatherworking activities (Barrio 2007: 20, pl. III). Therefore, comparisons and contextual evidence point towards these four tools being used for leather production as saddler knives.

The main differences between the four examples can be reduced to two details. Firstly, the method of fixing the handle: the two Porqueres knives are socketed, while the remaining two from La Bastida and El Cigarralejo are fixed with rivets. Secondly, the knife of La Bastida has an unusual hole in its bottom corner, which can be theorised to have been used to tie the blade to the haft. Another use could be that of reducing the width of leather strips by forcing them through the hole, although for that to be possible, the hole would have needed to be sharp on the inside. Given the current state of the knife, it is impossible to determine either use.

Lastly, the discovery of the knife in Grave 333 may seem contradictory, as the other tools, such as the unhairing knives, point towards tanning as the main process for which the tools were used. For one, though, unhairing was also carried out by certain leatherworkers like *boteros*, in the preliminary stages of their craft (Castellote 1987: 183). Secondly, a robust knife designed for cutting through thick hides, as is the saddler’s knife, would have been seen as useful by the possible tanner, whose work also included cutting and stitching skins together in later tanning phases, as shown also by the presence of the awls.

Awls

Awls are pointed tools designed for piercing leather, necessary for stitching hides together, a task present both in the tanning process as well as in various leatherworking crafts. The main feature of these simple tools, a pointed end, leads to considerable variety in the shapes taken by these tools when they appear in the archaeological record. Excepting the awl from Room 2 of Los Villares (Caudete de las Fuentes) identified by E. Pla (1968: fig. 40), the rest of the awls belong to the bipyramidal shape comparable to awl types 1 through 3b as described by Manning (1985: 39–41).

Before continuing and detailing the awl types, it is necessary to recognise that there is often certain confusion regarding the bipyramidal awl, due to its resemblance to the also bipyramidal-shaped ‘Numantia type’ arrowheads. This confusion is exemplified by the awls from El Cigarralejo, interpreted variously as arrowheads, javelin points and punches (Cuadrado 1987: 323, no. 1604; 492, no. 2843; 377, no. 1797; 387, no. 1924). This issue, however, can be more readily resolved thanks to recent advances in military archaeology, specifically the research of the battlefield of *Baecula*, which took place in the context of the Second Punic War and has been located at the site of Cerro de las Albahacas (Santo Tomé, Jaén). Here, 136 bipyramidal arrowheads were discovered, the largest set unearthed so far. 96% of these heads measured between 3–6 cm and weighed between 2–6 grams (Quesada *et al.* 2015: 359–363). That is, far smaller than most of the awls studied here. The remaining 4% of the bipyramidal *Baecula* arrowheads did not fit into

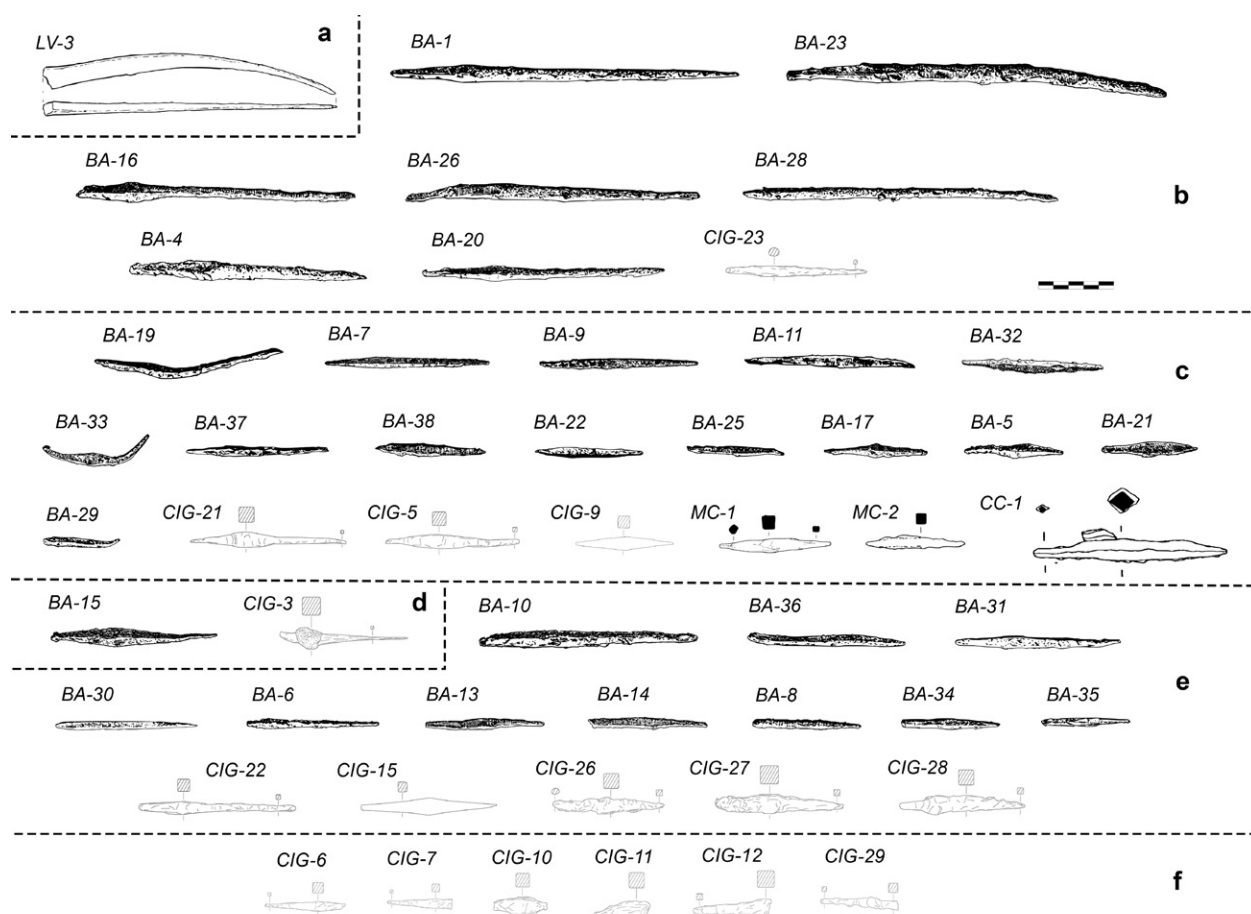


Figure 6. Awls. a) Pla awl-type; b) Manning Type 1; c) Manning Type 2; d) Manning Type 3 a; e) Manning type 3b; f) No evident type. Awls from Los Villares (Caudete de las Fuentes, Valencia) – LV – (after Pla 1968); from La Bastida de les Alcusses (Moixent, Valencia) – BA – (after Fletcher *et al.* 1965, 1969); from El Cigarralejo (Mula, Murcia) – CIG – (by the author); from Mas Castellar (Pontós, Girona) – MC – (after Rovira 2002); and from Cerro de la Cruz (Almedinilla, Cordoba) – CC – (after Vaquerizo *et al.* 2001).

this paradigm due to their greater size, the largest of which was theorised to be an awl of some sort at 8 cm long. The closest parallels identified for these longer arrowheads were the specimens from Graves 161, 204, 333 and 283 considered here; in their discussion, the authors leaned towards considering the latter as awls or punches, pointing out that in general, when arrows are deposited as grave goods, they tend to appear in greater numbers (Quesada *et al.* 2015: 364).

Furthermore, while Iberian studies have not recognised bipyramidal points as awls, it is frequently done in the case of several contemporary Celtiberian and Vaccaean necropoleis located in the interior of the Iberian Peninsula (Barril 1992: 9–10, 24; Jimeno *et al.* 2004: 281; Sanz Mínguez 1996: 415–416). Similarly, this type of awl was recognised and established by W. H. Manning (1985: 39–41), working with the Iron Age and Roman iron tools of the British Museum, as well as A. Duvauchelle (2005: 83–85) working with the iron tools of the Museum of Avenches. Nevertheless, as noted by G. Kurtz (1996: 335), it is quite frequent for bipyramidal points to be considered awls without evidence of any other leatherworking tools. In the Iberian case study however, these objects frequently appear alongside other identifiable leatherworking tools: Graves 161, 283, 333 and 431 from El Cigarralejo, and Rooms 63 and 82 of La Bastida de les Alcusses. Thus, a strong case is to be made for considering these objects to be tools, and not arrowheads, and specifically awls for leatherworking.

Iberian leatherworking awls can be separated into two main categories: bipyramidal-shaped and curved awls. The only curved awl is the specimen from Room 2 of Los Villares, identified as such by E. Pla (1968: fig. 40) due to its close similarity to traditional shoemaker's tools.

The bipyramidal specimens can in general be catalogued following the types established by W. H. Manning (1985: 38, fig. 9), including Types 1, 2, 3a and 3b. Manning Type 1 has a long tapering stem with a circular cross-section, a defined shoulder and a short tang, which would be fitted with a handle; seven specimens fit this description, one smaller example from El Cigarralejo – CIG-23 – and six large specimens from La Bastida, all with circular cross-sections and pyramid-shaped heads for fitting into a wooden handle. Manning Type 2 is defined by its diamond-shaped head that continues into a long stem, with a shorter tang for fitting a wooden handle: this is by far the most prevalent type, with 21 specimens. It is necessary to add to Manning's original type, by distinguishing between the smaller specimens measuring between 5 and 7 cm in length, with which particular care must be taken to not confuse them with bipyramidal arrowheads, and those measuring between 7 and 15 cm in length. The smaller Type 2 awls have not been identified as bipyramidal arrowheads such as those found in Baecula in the study on the weaponry of La Bastida and bear a strong resemblance to the larger awls. Manning Type 3 awls are diamond shaped with one blunt end, meant to be directly gripped by the user. Type 3a are more carefully made, with blunter heads – CIG-22 –, or topped by a small sphere – BA-15 – similarly to the specimen found in the grave of a Roman shoemaker discovered in Trier (Germany) dating to the 2nd century AD (Leguilloux 2004: 68). Manning Type 3b awls are more roughly shaped, usually with rounded edges, and as in the case of Manning's catalogue, and here number ten.

Shears

Shears (Figure 5) are a recurring part in leatherworker's toolkits (Castellote 1987: 182). Nevertheless, as occurs with certain other tools such as needles or even common knives, shears are generally versatile and multifunctional tools that can be employed for a wide range of possible uses. Recent studies have attempted to develop a method aimed at reducing this range by careful analysis of the morphometric characteristics of the shears (Swift 2017; Busana, Francisi, and Spagiari 2020; Rosell and Spagiari 2022). According to these studies, the identification of shears used in leatherworking activities must be reached by a careful appraisal of the formal characteristics of the piece as well as its immediate context. A recent study focusing on Iberian shears of modern-day Alicante province considered leatherworking to be a possible use of several shears not included here (Rosell and Spagiari 2022: 41–45). However, in many of these cases, leatherworking was mentioned as only one of many uses, often without further contextual evidence. This study will only focus on those shears that can be linked to leatherworking due to the presence of other tools in their surroundings. Thus, of all the Iberian shears, only four can truly be considered to have been used in leatherworking activities.

Two were located in the settlement of La Bastida de les Alcusses. Both are fragments, consisting of part of the upper half of the blade and part of the handle. The specimen from Room 4 can be linked with leatherworking due to the lunette knife found in the adjoining Room 3, with which it constitutes Building 17 (Bonet and Vives-Ferrándiz 2011a). Similarly, the blade found in Room 63 appeared alongside an awl, and another awl in the also adjoining Room 64. Both shears can also be linked to textile production, due to the presence of spindle whorls in Rooms 3 and 62 (Rosell and Spagiari 2022: 44). However, this should not surprise or appear overly concerning instruments, as shears are specifically designed to be versatile in such a way as to avoid needing a multitude of hyper-specialised instruments (Swift 2017: 96–97).

A more direct link with leatherworking can be found in the case of the two shears found among the goods deposited in Graves 20 and 161 of El Cigarralejo. Both contain lunette knives, and in the case of the latter, a series of awls. The presence of the two shears, therefore, can easily be linked to leather production. Each pair, in this case, also exemplifies the different types of shears used in this type of work. The blade fragment found in Grave 20 is wide and would have belonged to a large pair of shears. The most informative detail, however, is its L-shaped cross-section. This type of cross-section has mainly been

documented among Roman era shears and serves to provide the blade with greater strength and rigidity (Duvauchelle 2005: 77). This greater strength would have been ideal for cutting through tough hides. In contrast, the pair of shears in Grave 161, preserved whole, measures 20.5 cm in total, and therefore among the smaller of the ‘Medium Type’ shears identified by Manning (1985: 34), and its morphology would have made it ideal for the task of sheep-shearing (Busana, Francisi and Spagiari 2020: fig. 2). In this case, it is evident that the shears, regardless of a possible original intention geared towards sheep-shearing, was used for cutting leather, further evidence of the versatility of these instruments.

Others: needles and common knives

Regarding other tools that would have doubtlessly been used by tanners and leatherworkers alike, such as needles or less specialised knives, their identification is much more difficult.

Needles do not appear in any of the mentioned graves from El Cigarralejo. Regarding settlement contexts, only one needle has been found close to recognisable leatherworking tools. This is the case of a needle for weaving esparto grass (Figure 5) found in Room 75 of La Bastida de les Alcusses (Fletcher *et al.* 1969: 162, no. 71), the room immediately next to Room 80. The thickness of the needle may have been helpful when punching through the hide. However, it may also have been excessive for the detailed work for which a small lunette knife such as the one found in Room 80 would have been used. For these reasons, this needle is mentioned only as a possible leatherworking tool.

Everyday knives are more frequent, but also more problematic. Knives are found in two of the graves from El Cigarralejo: Graves 161 and 333 (Cuadrado 1987: 323, fig. 133, 547, fig. 238). It is much more probable that, as occurs in many other graves as part of an extended practice in Iberian necropoleis, these knives would have accompanied the falcata swords that were also deposited in these graves (Cuadrado 1987: 86). Similarly, interpreting knives as leatherworking tools when found in settlements is risky. As will be seen below, many of the specialised leatherworking tools were found in domestic assemblages that are characterised by the fact that multiple tasks were carried out in the same space. Thus, it is as likely, if not more so, that the knives were used for cutting textile fibres or for food preparation. These knives ought to be seen, therefore, only as possible tools unless there is clear contextual evidence to the contrary.

Overview

Overall, more tools can be linked to the different leatherworking activities – shoemaker, saddler, wineskin-maker – than to the tanning process. The degree to which one sphere has an advantage over the other is not as clear as it may seem, as certain tool types, such as awls or even shears, were used by both tanners and leatherworkers. Specialised tanning tools include only unhairing knives. Specialised leatherworking instruments include lunette knives, shoemaker knives and saddler knives; although, as Grave 333 of El Cigarralejo shows, tanners could also employ saddler knives. The reduced presence of tanning is simple to explain: no tanneries have yet been discovered, and of the seven unhairing knives, the six which can be securely identified as such were deposited as grave goods. Leatherworking tools are more readily found in settlements, most likely as this was where the products themselves would have been crafted. The higher frequency with which tools such as awls appear can be linked to their lesser value, which would explain why their owners were less reluctant to abandon them, and to their use for conducting everyday repairs of lightly damaged leather objects (Jimeno *et al.* 2004: 281).

Despite the slant towards the 4th century in the Iberian southeast, the catalogue does allow for some general observations. For instance, while typological variations do exist, they do not seem to reflect regional dynamics or evolution over time. Differences in shape reflect differences in usage, which can verge on the highly specific. For example, among lunette knives, the ‘U-shaped’ type is geared towards increasing applied force; among the tanged subtypes, the rectangular blade reveals a focus on skiving, while the smaller size of the specimens from La Bastida de les Alcusses makes them more adequate for precise cuts. This suggests the existence of a highly specialised selection of tools, differentiated one from another in minor details per the needs of the specific craftsman, the abilities of the blacksmith, or both.

It also implies a similar degree of tool specialisation throughout the Iberian world, or at least within the Iberian southeast; nevertheless, without further evidence, this conclusion must be treated as provisional. Lastly, this toolkit was also accompanied by other far less specialised tools: shears, needles, and common knives. These highlight another side of the leatherworking toolkit: versatility, and an eye for function over form. When understood in their context, this apparently contradictory dichotomy makes sense.

Leatherworking in context: work, society, and identity

Domestic Assemblages

While tanning was most likely an activity carried out beyond the settlement walls, due to the smell of the tanning agents involved, the discovery of leatherworking tools within the settlement leads to questions regarding the spaces in which they would have been used, and the existence of possible workspaces. The settlement of La Bastida de les Alcusses, the best case-study in this regard, offers three possible areas for leatherworking, centred around the spaces in which the tools were found: Room 3 in Building 17, Room 80 in Building 11, and Room 63 in Building 5.

Building 17 is made up of two rooms, Room 3 and Room 4, with a total surface of 21.5 m². It is surrounded by open space, part of which was used by the inhabitants of Building 17: this is the so-called Rooms 1 and 2, names given to spaces on either side of a small wall projecting from Room 3's eastern side. Room 3 is a small rectangular space measuring less than two metres in length. No visible doors or windows link it to the adjacent Room 4, which suggests it was accessed from above, a possible second story. Room 4 is slightly larger, with a doorway located in its northern side (Fletcher *et al.* 1965: 27, 33, 39, 45). Leatherworking tools are spread out: a lunette knife in Room 3, a pair of shears in Room 4 and an awl in Room 2. This is not the only evidence of production in this Building: Rooms 1 and 2 contain ample evidence of weaving, with 14 and 20 documented loomweights, respectively. Their location in this open space is not surprising, weaving often took place outdoors where there was better light (Bonet *et al.* 2011: 169–170). There are also farm implements: a sickle each in Rooms 1, 2 and 4, as well as a hoe in Room 3 (Fletcher *et al.* 1965: 29, 36, 43, 46). Lastly, a large lead sheet found in the building, (no particular Room is mentioned) is linked to the refining processes of lead glance, from which silver is extracted and lead remains as leftover (Pérez Jordá *et al.* 2011: 115–119; Vives-Ferrándiz 2013: 101, fig. 5; 2022: fig. 7). The Building also contained several ceramic containers and, interestingly, remains of weaponry – a spear butt in Room 1 – as well as imported pottery – an Attic black glaze bowl in Room 1, a large black-glaze Attic plate in Room 3 and fragments of Red-Figure Attic pottery in Room 2 (Fletcher *et al.* 1965: 27, 33–34, 39). This Building is not considered a house, due to the lack of a hearth and of a millstone, typical domestic attributes in the site, and rather a constructed space that could be linked to some of the greater houses in the vicinity (Bonet *et al.* 2011: 142), which would also explain the presence of an assemblage otherwise very similar to the materials discovered in identified houses. Regardless, the activities carried out in Building 17 overall point to leatherworking sharing space with other craft activities such as metal work and textile production, possibly even sharing the shears with the latter.

Building 11 is a far larger house of 11 rooms, many of them small.² Its total surface is approximately 147 m². It is located to the north of one of the main roads crossing the *oppidum* from east to west. It is among the wealthier houses of the settlement: two ploughshares and two spuds, both linked to ploughs, were located in this house, an indicator of land possession for the team researching this settlement (Vives-Ferrándiz 2013: 100–101; 2022: 252). The grain thus produced was ground in the millstone located in Room 72 (Fletcher *et al.* 1969: 134, no. 23). Furthermore, as in Building 17, it also contains evidence of silver extraction, evident in a lead sheet as well as a set of scales, the latter an indicator of precise measuring and accounting (Vives-Ferrándiz 2013: 101–102; 2022: 252–253). Textile implements are present, but in small numbers that do not allow for identifying specific looms as in Room 2 of and possibly Room 1 of Building 17 (Fletcher *et al.* 1969: 104, 158, 171–172, 185). These sources of wealth are reflected in the

² Rooms: 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 79. Open spaces next to Building 11 and used by its denizens: 'Rooms' 78, 80, 81 and 82 (Fletcher *et al.* 1969: 89–195).

many luxury imported vessels found here, Building 11 being one of three buildings (alongside Building 15, another domestic context, and Building 7 that is a large warehouse) with the largest accumulation of Greek vessels (Vives-Ferrándiz 2022: 253). In this context, leatherworking tools include a lunette knife in Room 80, seven awls spread out among Rooms 71, 75, 78 and 80, as well as an esparto knife that could possibly have been used, in Room, 75. It is of special interest to note that Room 80 is in reality an open space formed by two walls at a right angle, and may have been under the cover of a porch (Fletcher *et al.* 1969: 181); along with the adjoining Room 75, a large rectangular space connected to Room 80 by a wide entrance on its eastern side, these two spaces contained six of the ten identified leatherworking tools. In this context, once again, leatherworking is only one of several types of production, and as in the case of the looms of Room 1 and 2 of Building 11, leatherworking here seems to have taken place outdoors where there was a better source of light; perhaps that explains the four spindle whorls also found in Room 80, possible evidence of the spinning of yarn.

Lastly, Building 5 is a large structure of some 400 m², located apart and at the highest elevation of the settlement. It consists of three large spaces – Rooms 63, 64 and 65 – identified as the residence and storehouse part of the building, a large patio for celebrations– Room 62 – and a further, smaller space, Room 61. It has been identified as a public building used for political purposes such as celebrations, meetings, or significant exchanges (Bonet and Vives-Ferrándiz 2011a: 90; Vives-Ferrándiz 2013: 106; 2022: 257). There are certain exceptional architectural elements such as floors of hardened mud, a floor of flagstones and coloured plaster on the walls (Fletcher *et al.* 1969: 55; Bonet and Vives Ferrándiz 2011a: 90). There is a lack of evidence of work activities, be it food processing or silver extraction, and agricultural tools are practically absent. There is, however, possible evidence of leatherworking: the shear fragment BA-18, and several awls, BA-16, BA-17 and BA-19. Furthermore, three spindle whorls appeared in Room 62 (Fletcher *et al.* 1969: 58, nos. 8–10). The identification of both textile and leatherworking activities from this evidence is somewhat tenuous, and hinges on the interpretation of a markedly multifunctional tool such as the shears BA-18. It is also complicated by the otherwise total lack of work activities detected in the material assemblage, contrasting with the case of other residences. As it is, however, the coexistence of leather and textile work follows a pattern similar to the prior examples.

Moving beyond these contexts, evidence of leatherworking is less clear. The possible unhairing knife of La Bastida was found in Room 126, which has been characterised by the team studying the *oppidum* as part of a large warehouse located in the centre of the settlement (Bonet and Vives-Ferrándiz 2011a: 88–89; Vives-Ferrándiz 2022: 255–257). Nevertheless, lacking further information on the material assemblages of Room 126 and the surrounding spaces, little more can be said. Other rooms in La Bastida de les Alcusses contain at best one or two awls, but in these cases, as in other Iberian buildings in which a single awl was found – such as the two large aristocratic houses of Mas Castellar de Pontós, or Room O of Cerro de la Cruz (MC-1, MC-2, CC-2) – the awls can be understood as being used for carrying out everyday repairs, rather than the production of leather products (Jimeno *et al.* 2004: 281).

A last case worth mentioning is that of Los Villares. Here, in Room 20, the oldest lunette knife of this compilation was found, documented in a level dated to the 6th century BC. However, due to the fragmented evidence of this early level, little more can be said beyond that it too is a purely domestic assemblage (Mata 2019: 132). The other lunette knife was found in the space termed ‘the Forge’, located within House 2. This space contained evidence of a forge hollowed out in the floor, many fragments of lead slag, as well as a pair of small iron tongs. A hoe was also found, which may have been used to remove ashes and other residues (Mata 2019: 134–137). Another possibility is that the hoe and the lunette knife, following the observations of the team (Mata 2019: 137), were tools produced by the forge and stored before being transported to their destination. In any case, it seems improbable that leatherworking was carried out in this specific space due to the lack of other leatherworking tools.

In summary, then, our understanding of Iberian leatherworking spaces is restricted by the limited number of preserved tools, as well as by the unequal degree of information available depending on the case. Nevertheless, two distinct categories of leatherworking can be identified. Firstly, the casual repair

of the ubiquitous leather objects present in most contexts of Iberian life, represented by the lone awls found in many contexts. Secondly, leatherworking as the creation of leather products. It can be solidly identified in two contexts: Buildings 11 and 17 of La Bastida de les Alcusses. This evidence, highly specific to a single site dated in the 4th century BC, points towards leatherworking as one of several crafts and activities carried out by the members of the household, alongside textile production, farming, and silver processing. This does not deny, however, that the leatherworking itself was a specialised craft, the tools themselves suggest as much. It implies, rather, that the household was not dependent on leatherworking as its only source of wealth, even more visible in Building 11, one of the wealthier houses of the whole settlement. Regarding the identity and social status of the leatherworkers themselves, little can be said. There is little consensus regarding work activities carried out by the members of Iberian aristocratic and otherwise elite households: the best known is that of the women, who would have destined much of their time to textile work, both spinning and weaving. This is informed both by domestic assemblages themselves as well as by iconography (see Prados and Sánchez Moral 2020). In this sense, it is worth noting that in all three case studies from La Bastida de les Alcusses – Building 5, 11 and 17 – textile and leather activities took place close by or even in the same spaces. It is true that these spaces, especially porches and outside areas such as Rooms 80, 1 and 2, were the natural working locations due to the better access to light, but it is also true that they might well have shared tools: particularly, shears BA-3 and BA-18. Could the women of these households have been the leatherworkers in question? An alternative idea is that certain tools were readily shared between crafts and even sexes, which is also intriguing. The funerary assemblage provides more information in this sense.

Funerary assemblages

As well as the domestic assemblages described above, both tanning and leatherworking tools appeared in nine of the graves located in the necropolis of El Cigarralejo (Mula, Murcia). This is the largest concentration of graves holding identifiable leatherworking tools, excluding lone shears, in the Iberian world. It is also a tiny fraction of the more than 500 graves of El Cigarralejo, all of which occupied a small unmarked area on the slope of the hill of El Cigarralejo: the *oppidum* itself was located further above, and at the crest of the hill, the sanctuary (Cuadrado 1950). The limits of the necropolis, while unmarked, were well known, as shows the very frequent practice of graves cutting into others and their monuments above them (Cuadrado 1987; Graells and Pérez Blasco 2022: 76).

Iberian funerary practices are varied, and are beyond the scope of this paper, and a quick sketch is provided (see Blázquez 1992; Fenoll and Robles 2024). Iberian necropoleis do not include all the dead, merely a selection: the aristocracy, be it more or less hierarchical, and their clients and dependents. Iberian dead were cremated, and the remains would be then buried, both with and without an urn, in what could range from simple pits to carefully crafted niches of mudbrick. Most graves hold only one individual, but sometimes more in very few cases. To mark the graves, platforms of gathered stones or mudbrick could be erected, but could once again vary: the greatest were multi-tiered monuments of stone or mudbrick, while the simplest had no external markings at all. Grave goods were often deposited alongside the remains, although it is often difficult to distinguish between deposited ceramics and a possible funerary feast. The identity of the deceased is understood through the analysis of size and complexity of the grave, as well as the nature of the grave goods. This has led to many debates on all levels. Due to the cremation of the remains, the gender of the dead has generally been ascribed from the grave goods, which has spawned a debate as traditional gender roles applied from our present have been challenged (Chapa and Izquierdo 2010). Similarly, attempts at determining the wealth of the grave goods by counting the number of goods encountered issues such as the concept of wealth itself in Iberian culture: what is more valuable, a gold earring or several Greek vessels? Overall studies of wealth are useful for identifying both the most and least wealthy, but the nuances between large swathes of ‘free men and women’ are much harder to determine (Quesada 1994: 454–459, Grau and Comino 2021). But wealth is not equal to status (Quesada 1994, 1998: 196–197), although a part of it. The overwhelming presence of weaponry and imported goods in particular can be seen as an indicator of status; that is, to be interred in the necropoleis, the individual must belong to the social group able to access and acquire these prestige goods. And a last dimension

Grave	Chron.	Number Deceased	Grave features	Weapons	Imported ware	Personal adornment / toilet implements	Tools
20	375-325	Individual	No platform; round pit; no urn	Falcata sword; Spear	Black-glaze Attic plate		Lunette knife; Shears
161	400-375	Individual	Square stone platform; rectangular pit; with urn	Falcata sword; Spear; Throwing spear; Round shield		Fibula; redonda (B); Tweezers (I)	Lunette knife; Shears; Awls (3)
243	375-350	Individual	Square platform marked by stones, filled in; plastered pit; no urn	Falcata sword; Spear		Ring (B); Fibula redonda (B)	Lunette knife
283	300-200	Individual	Rectangular platform marked by stones, filled in with mud; plastered pit; no urn	Falcata sword; Spear; Throwing spear; Round shield		Fibula La Tène (B); Tweezers (B)	Lunette knife; Awl
333	325-300	Individual	Square platform of large stones filled in with smaller stones; rectangular pit; with urn	Falcata sword; Spear; Throwing spear; Round shield		Fibula redonda (B); Fibula La Tène (B); Possible Fibula La Tène (B); Tweezers (I)	Unhairing knives (4); Saddler knife; Awls (3)
431	400-300	Individual	Two tiered stone platform; plastered pit; with urn	Falcata sword; Spear; Round shield		Bead (bone); Beads (stone, 2) Ring (C)	Unhairing knives (2); Awls (4)

Figure 7. Table condensing relevant information on the grave goods and grave features of the funerary assemblages mentioned in the text. Sources: Cuadrado 1987, De Prada and Cuadrado 2019.

is that of ‘role’, or identity: while status is vertical, ‘role’ or identity is horizontal: within the group of ‘armed free men’, or that of ‘free women’, individuals occupy and assume social roles (Graells 2007), and even several (Crielaard 2018). The example of a possible *mistophoros* (mercenary) in El Cigarralejo is a prime example (Graells and Pérez Blasco 2022). So too are graves with tools.

Of the nine graves with tools related to leather production, focus will be placed on six: Graves 20, 161, 243, 283, 333 and 431. The remaining three, Graves 131, 204 and 209, include only a few awls, which must be read as tools used for secondary repairs. Notably, Grave 209 also includes a set of agricultural tools, the leather components of which would have benefitted from repairs. Relevant information regarding the graves is summarised in Figure 7. Some of the graves possess more elaborate platforms than others, as is the case of Graves 431 and 161. Regarding the location of the graves, Grave 431 is located in the eastern end where the older graves are located, as is Grave 283. In the case of the latter, it is a more recent grave that cuts into and lies over the line of stones marking the space around the rich Grave 277. The remainder are located in the ‘main body’ of the necropolis where it is frequent for the graves to superimpose one another, particularly during the latter half of the 4th century (a synthesis in Graells and Pérez Blasco 2022: 76). But overall, the graves reveal a marked set of similarities: they all contain weapons, and notably, the more valuable falcata swords, and five of the six contained personal adornments such as fibulae and even beads for necklaces. Similarly, three contain bronze tweezers – Graves 161, 283 and 333. Grave 20 is an outlier in this sense, as it has none of these personal adornments and is also the only one to contain imported Greek goods; this may be due to the severe alterations it suffered as a result of modern farming (Cuadrado 1987: 121). Lastly, it is noteworthy that there is little difference between those graves with tanning tools and those with leatherworking implements.

Excluding the iron tools, the assemblages belong to a prevalent trend in El Cigarralejo, that of graves with weapon assortments forming functional associations. In these graves, the possession of weapons is an indicator of identity, of belonging to a group of armed men of above average wealth (Quesada 2024: 280). Evidence such as the fibulae, often understood to have been offered alongside clothing, and toilet implements such as the tweezers, further reveal a care for highlighting the visual appearance of the

deceased (D'Onofrio 2017: 46). The inclusion of tools in the grave is a relative novelty: the scarcity of graves containing iron tools suggests that their inclusion is an individual, if not necessarily personal, choice. The graves make a show of linking the dead both to a larger group within the necropolis, that of armed free men, as well as to a specific craft, either tanning or leatherworking, suggesting the coexistence of various individual identities (Crielaard 2018).

It is necessary to consider the debate concerning the presence of tools in Iberian graves, which mostly concerns itself with graves containing shears, used for acquiring wool, and agricultural implements. Many authors consider that the tools were not actively used by the deceased, and ought to be read as an indicator of his or her source of wealth. They suggest this on the basis that the deceased is often accompanied by a wealthy set of grave goods, and that no lower-status individuals are allowed to be buried in the necropolis (Chapa y Mayoral 2007: 75–76; Galán 1989–1990: 194; Pérez Blasco in Graells and Pérez Blasco 2022: 155–157; Ruiz-Gálvez 1985–1986: 91–92). An alternative view is that of authors who believe that the tools accompanying the dead are simply the tools they used during peacetime, similarly to how their weapons were used in times of war (Gracia 2003: 89–90; Quesada 1994: 458; 2023: 249–250).

The case of the graves described differs from the most frequently debated graves as it concerns tools used in craft work. It further distinguishes itself in the sense that the six graves considered here reveal 'functional associations' as described above, save Grave 243. In other words, the tools were deposited as they would have been used together. This explains the presence of awls, an otherwise relatively simple and inexpensive tool. On the other hand, it must also be recalled that only the wealthier owners could truly permit themselves the luxury of burying the tools of their trade with their remains and thus depriving their families and dependents of their use (Verdú 2015: 308). The interpretation put forward here for Graves 20, 161, 243 and 283 is that they contained the remains of individuals of certain social standing, neither lowly nor among the wealthiest individuals of the necropolis, able to own expensive weaponry, and who were also leatherworkers. It does not seem surprising for skilled leatherworkers to occupy a position of certain status when considering the particular importance of horsemanship and horse ownership in Iberian society, particularly evident in El Cigarralejo: in the sanctuary, several hundred offerings of stone horses have been found (Cuadrado 1950), many with particularly elaborate harnesses. This is but one example of aristocratic uses for well-made leather products.

The case of Graves 333 and 431 may be similar, although their characterisation is hampered by our more limited knowledge of Iberian tanning. Tanners in Greece and Rome are disdained, but they are also mostly slaves; it is unknown if this is the Iberian case. Graves 333 and 431 are furthermore buried with a disproportionate number of unhairing knives which suggests an intention to make a show of their possessions rather than merely invoke their craft *pars pro tuto*: their weapons, in contrast, form purely functional assemblages, with no repetition. The deceased of Graves 333 and 431 may have been tanners, but it seems more likely in this case that they would have been the owners or masters of the tannery, those who could allow themselves the luxury of being buried with several tools.

Overall, the social position sketched for these graves is not unlike the warrior-craftsmen identified in Iron Age Italy (Buranelli 1979; Iaia 2006; Peroni 1981) or recently, in Iron Age Greece (D'Onofrio 2017), with the main difference being that in this case, instead of carpentry, the craft is leatherworking. Other graves in El Cigarralejo also contain assemblages containing weapons and tools for working wood and stone (Harding-Vera 2025).

Concluding remarks

The surviving remains of Iberian leather production allow only for a fragmentary reconstruction of what is known to have been a far greater reality. Thus, there is a significant absence of tanning activities, beyond the few recovered unhairing knives, and while leatherworking activities are more present, it is largely impossible to establish the specific professions carried out, whether shoemakers, saddlers or *boteros*, among others. Furthermore, the evidence is highly specific in space, time and even the type

of context: territorial *oppida* and necropoleis, both dominated by the presence of Iberian elites, in the southeast of the Iberian Peninsula during the 4th century BC. Only new evidence and discoveries can change this situation and fill in the gaps of the fragmentary record.

Nevertheless, the image, a ‘snapshot’, that can be pieced together for the 4th century is that of a specialised craft, as suggested by the existence of a specialised toolkit that in truly little differs from that of modern leatherworkers. The individuals who carried out this craft, however, did not necessarily belong to lower-status households, as shown by the houses of La Bastida de les Alcusses. Whether the individuals carrying out this work were of lower status within these households is currently unknown. The identified tanners and leatherworkers among the graves of El Cigarralejo were by no means of low-status in Iberian society: their inclusion in the necropolis, the size of certain platforms (Grave 431, 161), the presence of weapons, personal adornments and toilet implements, all point to their belonging to the circle of armed ‘free men’ closely related to the Iberian aristocracy.

However, this does not mean that all leatherworkers belonged to the circles of the aristocracy and their clients; the few identified craftsmen would not have been able to satisfy the needs of the entire population, most of which would have comprised peasants capable of servicing many of their needs. It suggests, rather, that the two crafts were considered aspects of personal male identity worth referencing, within the larger and encompassing identity of armed free men. It is similar to the role of carpentry in Iron Age funerary assemblages of other Mediterranean regions (D’Onofrio 2017).

Leather production would have far exceeded the scarce evidence currently unearthed. But it is noteworthy that the Iberian case-study, with all its current limitations, does provide an interesting and contrasting viewpoint to the general disdain afforded to workers by the Classical Greek and Roman authors. Craft activities, and the identities of those carrying them out, are not constant and universal, even if the *chaîne opératoire* changes little over time.

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Exploring domestic economies through network analysis: The case of El Castrejón de Capote

Lucía Ruano Posada,¹ Luis Berrocal-Rangel,² Pablo Paniego Díaz,³ Pablo Sánchez de Oro⁴ and Nerea Dacosta Menéndez⁵

Abstract

The hillfort of El Castrejón de Capote is a Late Iron Age settlement inhabited between the 4th and the 1st century BC. This study focuses on its final occupation phase, during which the site underwent significant transformations under increasing Roman influence. Drawing on a rich ceramic assemblage of over 2000 vessels, we apply social network analysis and GIS tools to explore patterns of domestic organisation and economic behaviour. By analysing the distribution, typology and functional associations of ceramics, we identify spatial and relational dynamics among structures, highlighting the emergence of specialised storage areas and multifunctional domestic units. Our results reveal a shift from isonomic domestic layouts toward greater functional differentiation, interpreted as an adaptive response to the political and economic demands of Roman integration. This approach demonstrates the value of network-based methods for reconstructing household practices and economic change in transitional frontier contexts.

Key words: Iron Age, pottery consumption, social network analysis, regional interaction, Roman networks

Résumé

L'oppidum d'El Castrejón de Capote est un habitat de l'âge du Fer récent, occupé entre le IV^e et le I^{er} siècle av. J.-C. Cette étude se concentre sur sa phase d'occupation finale, au cours de laquelle le site a connu des transformations significatives sous l'influence croissante de Rome. En nous appuyant sur un riche assemblage céramique de plus de 2000 vases, nous appliquons l'analyse de réseaux sociaux et des outils SIG pour explorer les modèles d'organisation domestique et les comportements économiques. L'analyse de la distribution, de la typologie et des associations fonctionnelles de la céramique nous permet d'identifier des dynamiques spatiales et relationnelles entre les structures, mettant en évidence l'émergence d'aires de stockage spécialisées et d'unités domestiques multifonctionnelles. Nos résultats révèlent un passage de schémas domestiques isonomiques vers une différenciation fonctionnelle accrue, interprétée comme une réponse adaptative aux exigences politiques et économiques de l'intégration romaine. Cette approche démontre la valeur des méthodes fondées sur les réseaux pour reconstruire les pratiques des ménages et les changements économiques dans des contextes de transition et de frontière.

Mots-clés: Âge du Fer, consommation de céramique, analyse de réseaux sociaux, interaction régionale, réseaux romains

Introduction

The study of domestic economies in Late Iron Age and early Roman Imperial settlements has emerged as a critical lens for exploring how households negotiated structural change, resource access and socio-political transformations (Bermejo Tirado 2022; Moreno-Navarro *et al.* 2023; Liceras Garrido *et al.* 2024). In this context, household archaeology offers a valuable entry point for understanding broader economic logics 'from below', by examining spatial arrangements, material practices and intra-site dynamics over time (Hendon 2004; Hirth 2009, Beaudry 2015).

The hillfort of El Castrejón de Capote, located in the southwest of the Iberian Peninsula, stands as a key case study for exploring these dynamics in the context of the Celtic *Baeturia*. Occupied from the 4th century until its abandonment in the early 1st century BC, the settlement underwent significant spatial, economic, economic and political changes associated with the progressive Roman expansion into the region after 152 BC (Berrocal-Rangel 1992, 2007). Recent archaeological investigations have revealed an

¹ UNIARQ, Universidade de Lisboa; lucia.ruano@edu.ulisboa.pt

² Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid; luis.berrocal@uam.es

³ Institut für Archäologische Wissenschaften, Universität Freiburg; pablo.paniego@ufg.uni-freiburg.de

⁴ Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid; pablo.sanchezdeoro@uam.es

⁵ Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid; nerea.dacosta@predoc.uam.es

extensive and well-preserved complex of domestic, storage and ritual structures, largely intact due to the site's abrupt abandonment during the Sertorian conflict (Berrocal-Rangel 2007), whose organisation and material culture offer valuable insights into the economic and social transformations that marked this transitional period (Berrocal Rangel *et al.* 2025; Ruano Posada *et al.* forthcoming).

Capote belongs to a network of hillfort-type settlements, positioned on strategic terrain for defensive and territorial control purposes (Berrocal-Rangel 1992). Earlier phases display relative architectural homogeneity and multifunctional domestic layouts, but stratigraphic and material evidence from the final phase (Phase 2a) suggests an intensification of household specialisation and a growing focus on storage (Berrocal-Rangel 1992; Ruano Posada *et al.* forthcoming). These changes parallel regional patterns observed in other Late Iron Age settlements, where domestic spatial differentiation and emerging economic asymmetries have been linked to broader processes of political centralisation (Parcero Oubiña and Ayán 2009).

The economic life of Capote can be reconstructed through its extensive ceramic assemblage, consisting of thousands of *in situ* vessels associated with distinct domestic, storage and ritual contexts (Berrocal-Rangel 1992, 2007). This material culture constitutes a rich dataset for examining patterns of pottery consumption, spatial distribution and functional differentiation within the settlement. While typological and provenance-based approaches have long dominated ceramic studies, recent advances in computational methods provide innovative frameworks for reinterpreting the relationships between material culture, domestic activities and settlement organisation (Brughmans and Poblome 2016; Brughmans and Peeples 2023; Orengo and Livarda 2021, Moreno-Navarro *et al.* 2024, Daems and Kafetzaki 2025).

This paper employs a dual-method strategy, integrating Social Network Analysis and Geographic Information Systems (GIS), to examine the economic organisation of Capote during its final occupation phase (2nd–1st centuries BC). Through the construction of bipartite and unimodal ceramic networks, we aim to i) analyse the relational dynamics between rooms and vessel types/functions; ii) identify central nodes, patterns of co-occurrence and modular clusters; and iii) explore how spatial specialisation and household strategies evolved in tandem with Roman political and economic integration. Complementarily, GIS-based analysis enables us to visualise and quantify spatial differentiation in ceramic distribution, identifying functional zones and concentrations of activity. These analyses are crucial for understanding how economic activities, storage facilities and consumption behaviours were organised within the settlement and whether they reflect broader socio-economic transformations related to Roman influence.

By combining these approaches, this study seeks not only to reconstruct the internal workings of Capote's domestic economy, but also to contribute to broader discussions on household agency, material practices and economic transformation in peripheral contexts of imperial expansion. Capote serves as a unique vantage point for examining how Late Iron Age communities actively responded to shifting political regimes – not through uniform processes of acculturation, but via heterogeneous adaptations embedded in the architecture and materiality of daily life.

Archaeological context: the hillfort of Castrejón de Capote

The Celtici territory

The territory inhabited by the *Celtici* in the southwestern Iberian Peninsula extended across parts of present-day southern Portugal and southwestern Spain, particularly in the provinces of Badajoz and Huelva and the regions of Alto and Baixo Alentejo. Their occupation is attested from the early 4th century BC to the 2nd century AD. While their material culture does not conform to the La Tène standard, the *Celtici* were identified by classical authors such as Pliny the Elder as Celts (*Naturalis Historia*, III, 13–14), particularly on the basis of language, religious beliefs and settlement names. This ethnographic identity appears distinct yet connected to the broader phenomenon of Celtic migrations and cultural diffusion into the Iberian Peninsula (Berrocal-Rangel 2012, Fernández-Götz 2007).



Figure 1. Distribution map of the archaeological sites mentioned in the text. 25 m DEM from the GMES RDA project (EU-DEM), and river courses layer from National 1:500.000 Base Map (BCN500 2015 CC-BY 4.0).

Their settlements followed a pattern of hillfort-type sites, strategically located near river valleys such as the Guadiana, Ardila and Múrtigas. Among these, *Nertobriga Concordia Iulia* (Fregenal de la Sierra) served as the principal regional *oppidum*, a hub that controlled routes of communication and exchange. These sites played a central role in defining the territorial cohesion and political structure of *Baeturia*. Notably, it is important to highlight that the concept of *Baeturia* was a Roman administrative construct; and the *Celtici* themselves were not referred to as ‘Baeturians’ in any indigenous context (Berrocal-Rangel 2012). The location of El Castrejón de Capote is especially significant within this landscape (Figure 1). While Nertobriga occupied a dominant position politically, Capote was more central in geographical terms. Located at the intersection of the Tentudía mountains and the valleys of the Múrtigas and Sillo rivers, Capote can be understood as a regional hub whose position was not only defensively advantageous but symbolically and logistically central.

The site of El Castrejón de Capote

El Castrejón de Capote, located in Higuera la Real (Badajoz, Southwest Spain, ETRS89 UTM Zone 29, X: 702684 Y: 4219546), is a fortified hilltop settlement with an occupied surface of approximately 3.5 hectares (Figure 2). It is naturally protected by the steep ravines of the Sillo and Álamo-Moriano rivers. The site was discovered in 1985, and systematic archaeological interventions were carried out between 1987 and 2006. These excavations yielded extensive information on architectural layouts, domestic assemblages, ritual contexts and socio-economic structures (Berrocal-Rangel 1992, 2007).

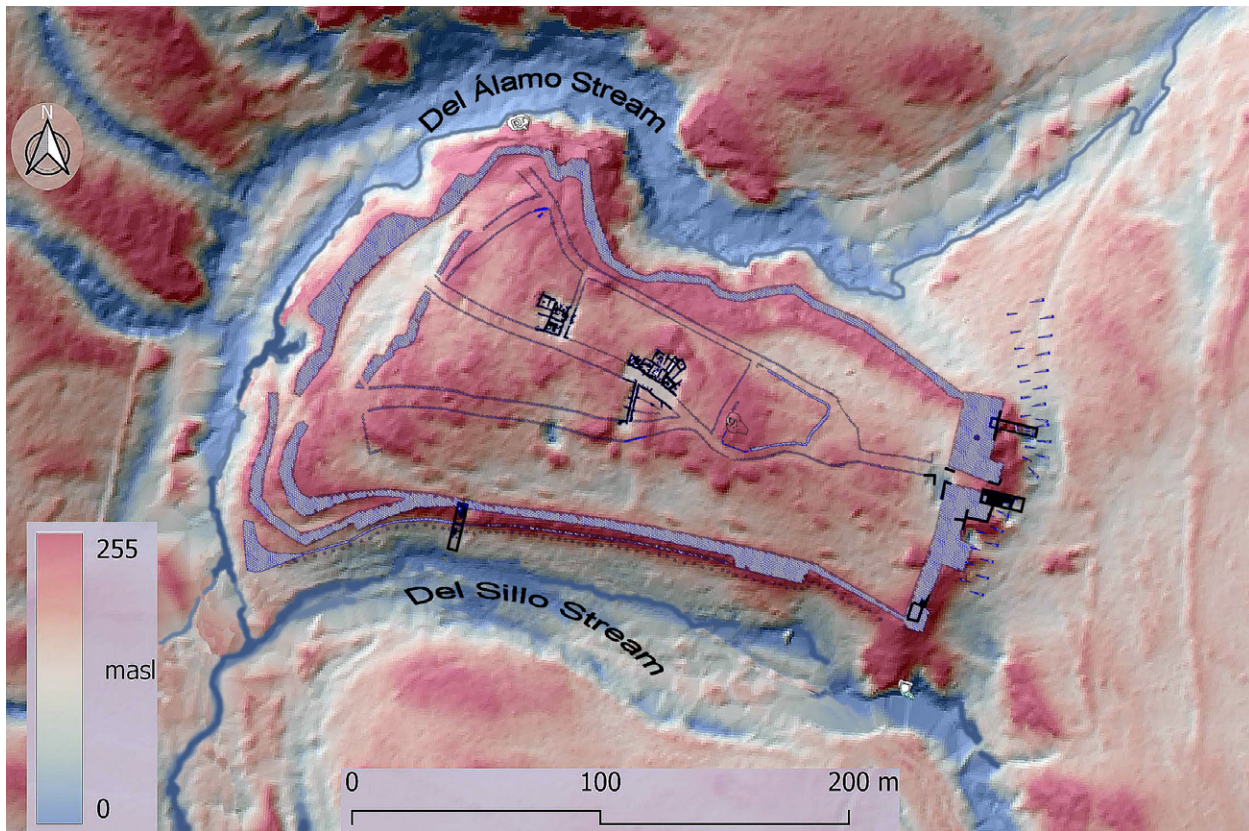


Figure 2. General plan of the site, showing the wall, excavated domestic structures, central sanctuary, and streets.

The excavations also revealed various phases of occupation, spanning from the settlement's foundation in the 4th century BC to its abandonment during the 1st century BC, amid the Sertorian War. The earliest phase of occupation (Phase 4, 4th–3rd centuries BC) corresponds to the initial establishment of the site. The site was already equipped with fortification walls and a monumental eastern gate, which would be reinforced by a fortress and a ditch over 11 metres wide. During Phase 3 (early 2nd century BC), the site expanded, and internal structures such as dwellings and communal spaces were reorganised. This phase may have ended violently during the Roman assault on the region, possibly coinciding with the historical siege of nearby Nertobriga in 152 BC.

Phase 2 is divided into sub-phases 2b and 2a. Phase 2b (ca. 152–138 BC) reflects a short period of post-siege occupation. It shows signs of rapid rebuilding using previous layouts, but with limited innovation. In contrast, Phase 2a (ca. 138–76 BC) displays more intensive occupation and greater architectural diversification, likely linked to the settlement of Celtiberian populations under Roman authority. This was a moment of adaptation to new political and economic circumstances, as seen in the increased presence of imported materials, the transformation of public and ritual spaces and the reorganisation of domestic life. The central sanctuary of Capote exemplifies these transformations. Originally constructed in the Iron Age, the sanctuary was a rectangular building with benches and an altar. It was carefully sealed and abandoned at the end of Phase 3, its space integrated into the domestic fabric of the settlement. This symbolic act marked the end of a communal ritual space and may be interpreted as evidence of changing ideological frameworks under Roman influence (Berrocal-Rangel 1994; Berrocal-Rangel *et al.* 2025).

The site was abruptly abandoned during the Sertorian War, around 76 BC. The sudden nature of this event has ensured remarkable preservation, with *in situ* finds including complete ceramic vessels, weapons, coins and ornaments. A final marginal occupation in the mid-1st century AD (Phase 1) is attested by a

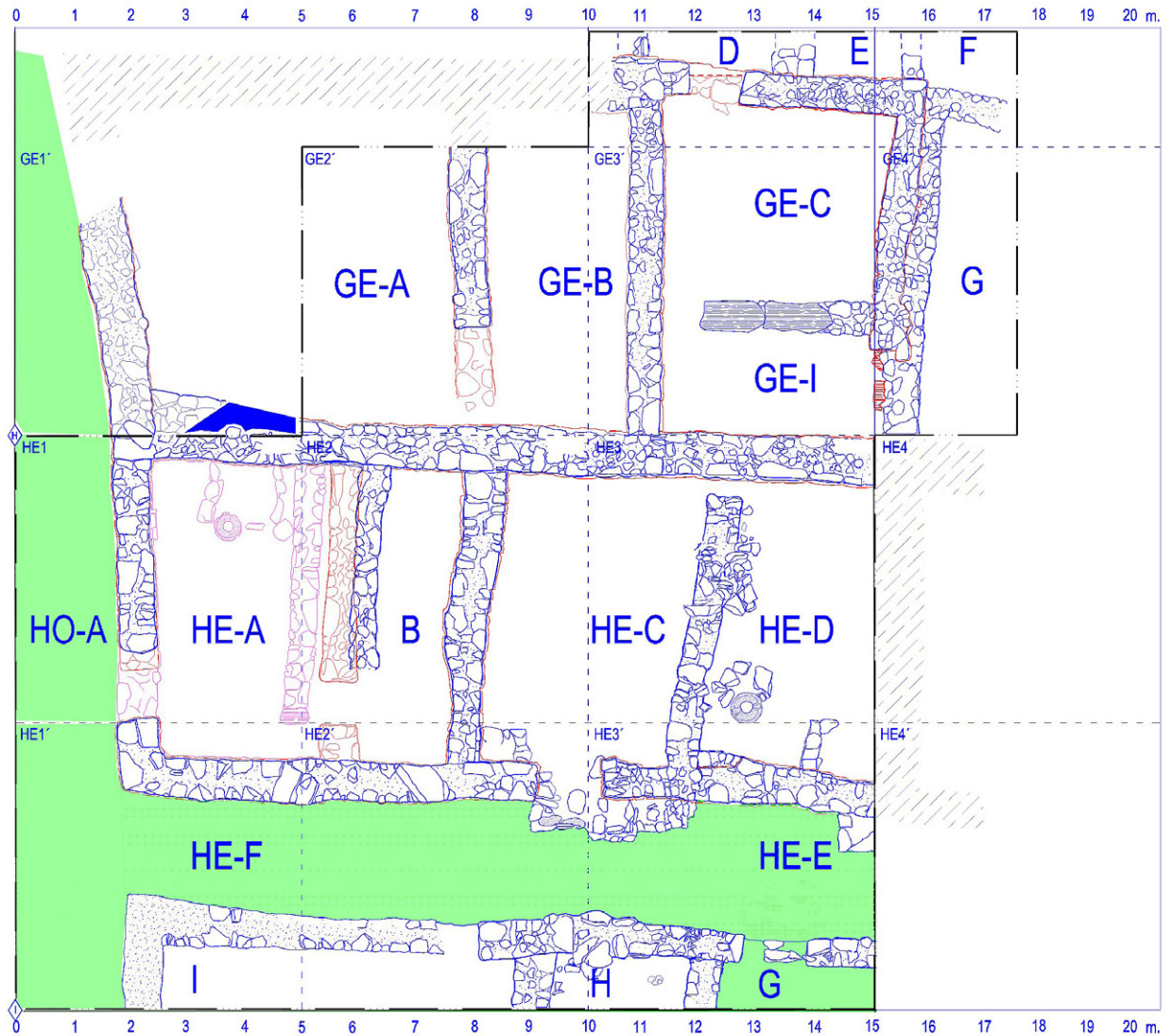


Figure 3. Cumulative plan of the western sector of Capote: Phase 3 (pink), Phase 2b (red) and Phase 2a (blue).

ritual deposition over the ruins of the fortress gate, possibly of commemorative or apotropaic nature (Berrocal-Rangel and Ruiz Triviño 2003).

Domestic structures and spatial organisation

The domestic architecture of Capote is one of the most informative in the southwestern Iberian Peninsula for understanding household organisation in the Late Iron Age. Excavations in the western neighbourhood of the site revealed eight main structures, of which at least four can be classified as domestic units (Figure 3). These units generally follow a bipartite layout, comprising a main living room with a hearth and workspace, and a smaller adjacent space used for storage (Berrocal-Rangel 1992; Ruano Posada *et al.* forthcoming).

Unit GE-CI exemplifies this model. During Phase 3, GE-C served as a kitchen and workroom, while GE-I functioned as a pantry or storeroom. In later phases, this structure was entirely repurposed for storage, suggesting a functional shift linked to broader economic changes. Similarly, GE-AB, initially a dwelling, was progressively restructured into two separate storerooms filled with ceramic vessels, some of which were found still on their original shelving. The HE-AB complex retained its bipartite character across

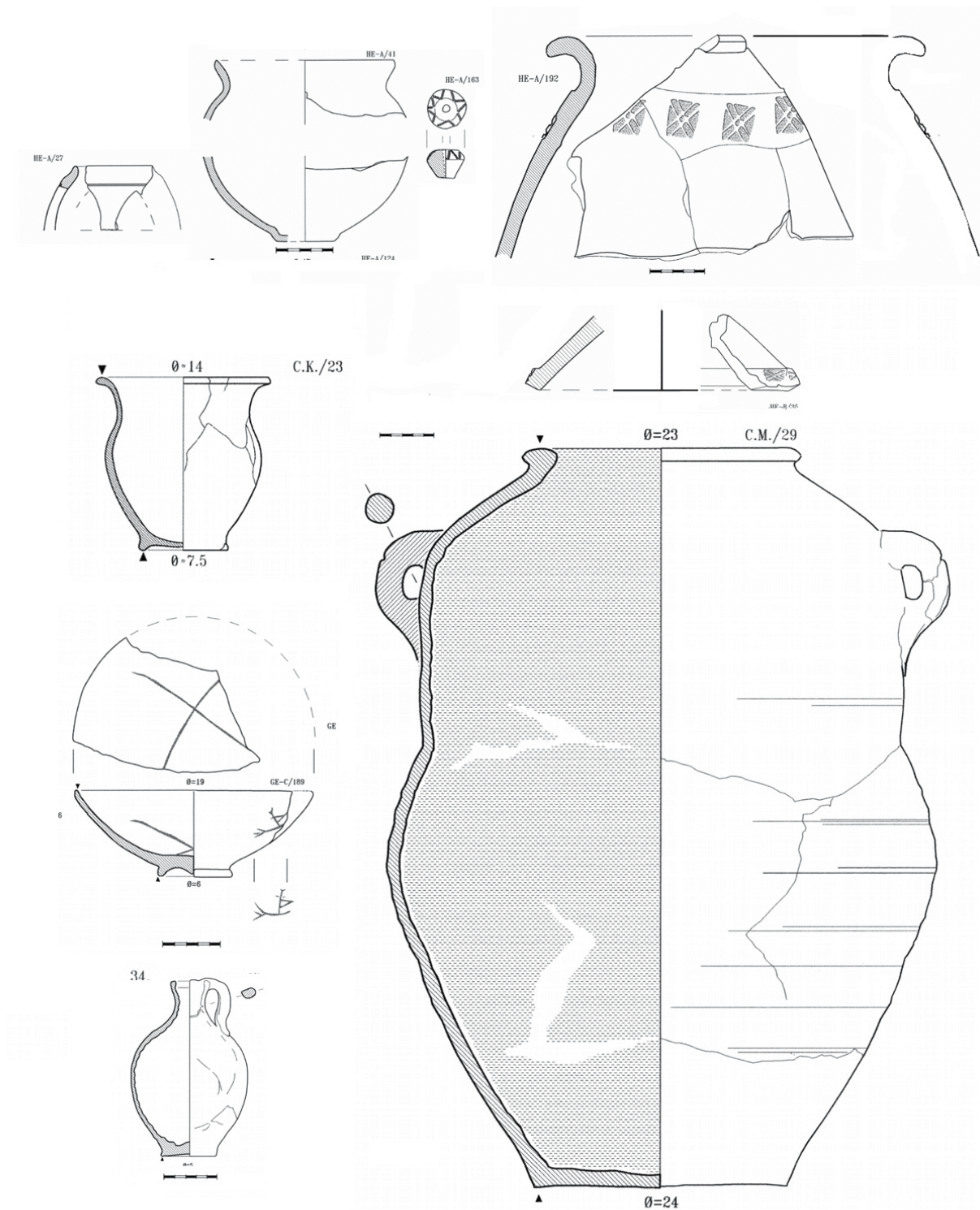


Figure 4. Selected ceramic forms documented at the site of El Castrejón de Capote (Phase 2a), representative of the repertoire used for the analysis.

multiple phases. In HE-A, superimposed hearths and a rotary mill point to a continuity of domestic and productive functions, whereas HE-B, with its slate flooring and abundance of stored material, retained its storage function. The progressive reduction of the storage room's surface in favour of the living area

may indicate shifting priorities or spatial constraints within the household. HE-CD presents a slightly more complex evolution. Initially composed of a single space (HE-D), it later incorporated a second room (HE-C), likely used for storage. Eventually, these were separated into two distinct structures, and HE-C, accessible via a stepped entrance, became one of the principal storage areas in the settlement.

The presence of over 2,000 ceramic vessels in this neighbourhood illustrates the growing importance of storage as an economic strategy. Also, the layout and transformation of these domestic structures illustrate a significant degree of architectural flexibility and a capacity to adapt to changing economic and political contexts. The increase in storage capacity, the spatial segregation of functions and the architectural modifications all reflect an intensification of household economies during Capote's final phases of occupation (Ruano Posada *et al.* forthcoming).

Material culture and economic practices

The material culture recovered from El Castrejón de Capote is notably abundant and diverse, offering a rich source for exploring the economic and social dynamics of its inhabitants. Among the artefactual record, ceramic vessels constitute the most prominent category, both in quantity and preservation. Thousands of fragments and complete vessels were recovered during excavation, many of them in primary deposition contexts. These ceramics represent a broad chronological sequence but are particularly concentrated in the final phase of occupation (Phase 2a), providing a snapshot of domestic assemblages in use immediately prior to the site's abandonment.

The ceramic repertoire comprises a range of locally produced coarse wares and imported fine wares, reflecting a mixed material economy shaped by regional traditions and growing external influences. The most common forms include large storage vessels of indigenous manufacture, alongside globular jars, cooking pots, small bowls and dishes, as well as imported forms such as Dressel 1 amphorae and Campanian black gloss wares (Figure 4). These were occasionally complemented by local imitations of Mediterranean tablewares, reflecting a mixed economy of regional traditions and external influences. The formal and technological variability of the assemblage suggests a spectrum of functional roles – storage, processing, service, and occasional ritual use – distributed across the domestic architecture of the site.

Samples and methodology

Recent advances in computational archaeology have underscored the potential of network science and spatial analysis for investigating domestic organisation, economic integration and material practices in pre-Roman and Romanised contexts (Brughmans and Peeples 2023; Moreno-Navarro *et al.* 2023). These methods enable archaeologists to move beyond static typological frameworks and explore the relational and spatial dimensions of material culture, identifying patterns of interaction, clustering and structural differentiation across domestic units (Knappett 2013; Brughmans 2010). The approach applied here builds on this analytical tradition by combining Geographic Information Systems (GIS) and archaeological network analysis to reconstruct the economic and spatial configuration of the hillfort of Castrejón de Capote during its final occupation phase (Phase 2a, 138–76 BCE). This dual methodology rests on the principle that domestic economies are not simply defined by the presence or absence of certain goods, but by the relational logic that structures how these goods circulate, co-occur and accumulate within space (McCoy and Ladefoged 2009; Brughmans and Poblome 2016). In this sense, networks and spatial models allow us to address questions concerning the internal organisation of households, the degree of functional specialisation and the emergence of economic inequalities, while also assessing the broader integration of local practices within supra-regional dynamics of political and economic change.

Dataset and sampling strategy

The ceramic dataset used in this analysis derives from the western sector of Capote, where extensive excavations have documented well-preserved architectural remains, stratigraphic sequences and ceramic assemblages. A total of over 2,000 significant ceramic fragments were initially identified. To

Figure 5. MNI of ceramic vessels per room at the western sector of Castrejón de Capote (Phase 2a), classified by functional category: storage, production, service, ritual and undefined.

Room	Storage	Production	Service	Ritual	Undefined	Total
GEA	13	0	5	0	1	19
GEB	12	0	6	0	11	29
GEC	16	0	17	1	16	50
HEA	27	9	19	0	30	85
HEB	11	0	5	1	17	34
HEC	34	9	30	0	21	94
HED	2	2	2	0	0	6
Total	115	20	84	2	96	317

ensure analytical clarity, the dataset was filtered using the Minimum Number of Individuals (MNI) method, resulting in a final sample of 317 vessels. These were attributed to seven excavated rooms across four units, all securely dated to Phase 2a (Figure 5).

Each vessel was classified according to its morphological type and presumed function (e.g., storage, cooking/production, service or ritual). Spatial provenance was also recorded for each item. Only ceramics with secure contextual information were included. Artefacts lacking clear provenance, typological classification or chronological assignment were excluded to ensure analytical robustness. The focus on ceramic materials reflects both their abundance at the site and their relevance as indicators of domestic function, economic activity and social organisation. Other artefactual classes, such as lithics or metal, were not incorporated into this preliminary study.

GIS-based spatial analysis

The spatial dimension of the ceramic distribution was examined using a suite of GIS tools. Each ceramic item was plotted according to its precise intra-site coordinates, allowing for a detailed mapping of vessel types and functional categories within the site. To detect areas of activity concentration, Kernel Density Estimation (KDE) was applied, with a particular focus on storage and service vessels. This technique reveals well-defined spatial clusters, indicative of zones with concentrated economic activities. The KDE surfaces were cross-validated against architectural layouts to identify correspondences between ceramic hotspots and specific domestic units. In addition, clustering analysis was performed on the ceramic dataset to identify groups of rooms sharing similar functional profiles. This enables the delineation of spatial zones with convergent economic roles, distinguishing between multifunctional domestic areas and rooms functioning as specialised storerooms. Although initial considerations were given to implementing visibility analyses – to assess lines of sight between structures or streets – this component was ultimately excluded due to the lack of detailed architectural elevation data. Nevertheless, the spatial models generated through KDE and clustering analysis offer a robust platform for interpreting functional organisation within the settlement.

Network archaeology: construction of relational models

We employed formal network models to analyse patterns of co-occurrence and functional association among ceramic vessels and domestic spaces at Capote. The network analysis was conducted in *R* and *Gephi*. Three distinct networks were constructed to analyse the relationships between rooms and ceramic materials:

1. **Room–Form Network:** The first analytical model was based on a bipartite network that connected domestic rooms to ceramic vessel forms. In this two-mode structure, rooms (e.g., HE-A, GE-C) were

	GEA	GEB	GEC	HEA	HEB	HEC	HED
GEA	10	6	7	9	7	8	2
GEB	6	7	5	6	6	6	2
GEC	7	5	11	8	8	9	3
HEA	9	6	8	12	8	9	3
HEB	7	6	8	8	10	8	3
HEC	8	6	9	9	8	17	3
HED	2	2	3	3	3	3	3



Figure 6. Co-occurrence of ceramic vessel types across rooms. The table presents the number of shared vessel types between each pair of rooms based MNI counts. The heatmap visualises these values, with warmer colours indicating a higher degree of similarity in ceramic composition. R software.

linked to specific vessel types (e.g., storage vessel, dish, bowl, amphora, burner) according to their documented presence. This allowed us to examine the diversity of ceramic forms associated with each domestic unit and to evaluate functional variability across the settlement. To explore inter-room relationships, the bipartite graph was projected onto a unimodal network, where rooms are linked to each other when they share at least one vessel form. This projection enabled the identification of highly connected nodes within the spatial network.

2. **Room-Function Network:** The second model follows the same two-mode logic but shifts the focus to ceramic function rather than form. In this bipartite network, rooms are linked to functional categories (e.g., storage, service, production, ritual, undefined) based on the inferred use of each vessel documented in the assemblage. This approach highlights the spatial distribution of domestic activities and reveals contrasts between functionally specialised spaces and multifunctional units. By visualising overlaps in economic roles and ceramic use, the model provides insights into household-level economic strategies, degrees of spatial specialisation and possible coordination of domestic tasks across the site.

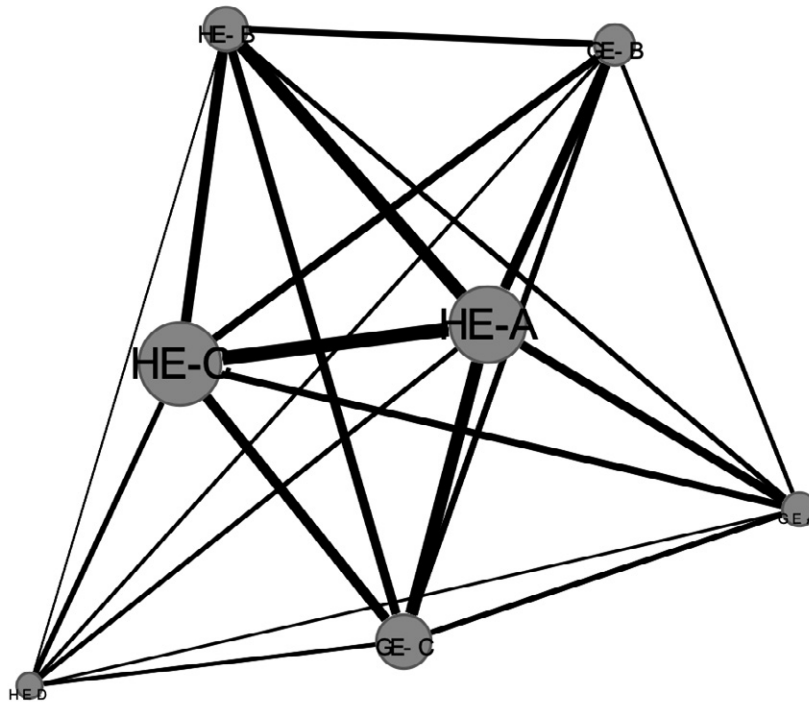


Figure 7. Network of rooms based on shared ceramic vessel types. Each node represents a domestic space, with its size reflecting degree centrality, and edges indicate the co-occurrence of vessel forms between rooms, with edge thickness reflecting the strength of the connection. Gephi software.

3. **Form–Form Network:** This third analytical model adopts a unimodal structure, in which each node represents a distinct ceramic form, and edges are drawn between forms that co-occur in the same domestic context. Unlike bipartite models linking rooms to artefact categories, this network examines direct relationships between vessel types themselves. The goal is to identify patterns of association among ceramic forms based on their simultaneous presence within individual rooms. This approach enables the detection of recurring functional pairings – i.e., vessel types that were habitually used together – offering insight into the composition of household activity sets. Network metrics were applied to assess the degree of connectivity between forms, and modularity analysis was used to detect clusters of forms with particularly strong co-occurrence. Through this model, it becomes possible to explore how different vessel types were combined in everyday practices, without reference to specific spatial units.

Integration and interpretation

The final stage of analysis integrated the GIS-based spatial patterns with the relational data from the network models. By comparing the results of both methods, we could validate observed functional distinctions and interpret them in a broader socio-economic framework. This integrated approach allowed us to move beyond static typological interpretations and instead reconstruct the dynamic organisation of space and economy in Capote's final occupation. Through this lens, the settlement's transition during the Roman conquest becomes legible not only in terms of external influence but as an internal reorganisation of domestic strategies in response to shifting socio-political conditions.

	GEA	GEB	GEC	HEA	HEB	HEC	HED
GEA	2	2	2	2	2	2	2
GEB	2	2	2	2	2	2	2
GEC	2	2	3	2	3	2	2
HEA	2	2	2	3	2	3	3
HEB	2	2	3	2	3	2	2
HEC	2	2	2	3	2	3	3
HED	2	2	2	3	2	3	3

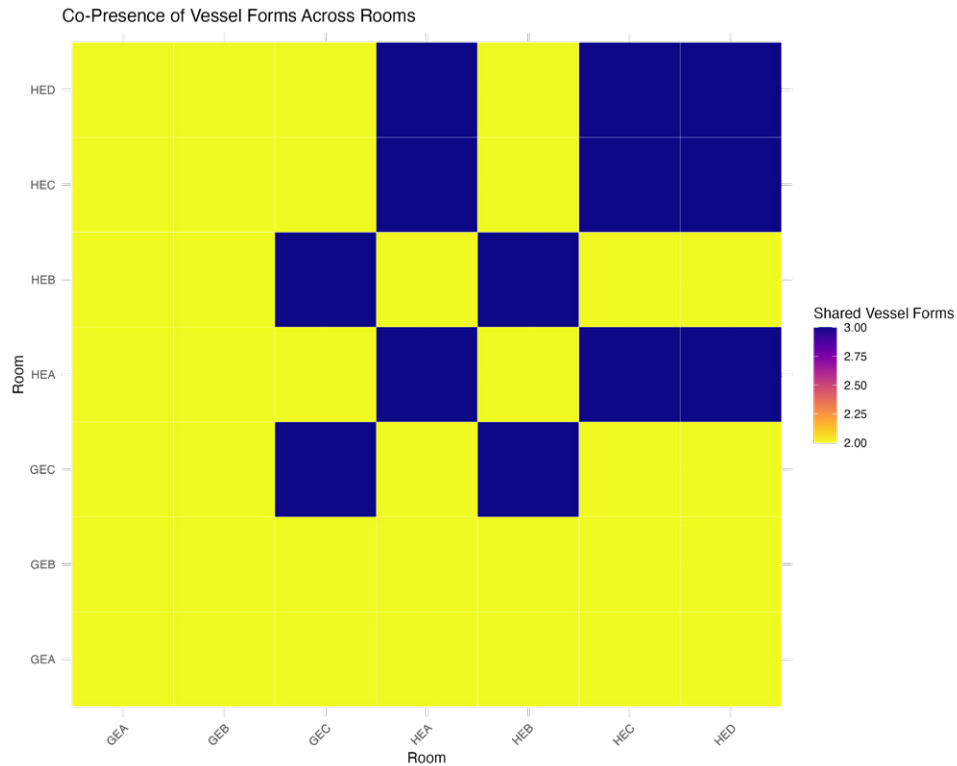


Figure 8. Co-occurrence of ceramic functional categories across rooms. The table presents the number of shared ceramic functions between each pair of rooms, based on MNI data. The heatmap visualises these values, with warmer colours indicating a higher degree of functional similarity between domestic spaces. R software.

Reconstructing domestic practices: results from network and spatial analysis

Network of rooms and vessel types

The first analysis explores the distribution of ceramic vessel forms across domestic units by modelling a bipartite network in which rooms are connected to specific vessel types based on their co-occurrence in the archaeological assemblage (Figure 6). This two-mode structure was subsequently projected into a unimodal network linking rooms that share at least one vessel type, allowing us to visualise patterns of ceramic overlap and domestic interaction (Figure 7).

Within this network, rooms HE-A and HE-C emerge as central nodes – not only in terms of the number of vessels they contain, but also due to the diversity of forms represented. Their high degree of connectivity suggests multifunctional roles encompassing storage, preparation and consumption activities. In contrast, rooms such as HE-B and GE-B exhibit fewer ceramic types and weaker ties, pointing to a more specialised or limited domestic function. Strong ties between HE-A, HE-C and GE-C may indicate a shared

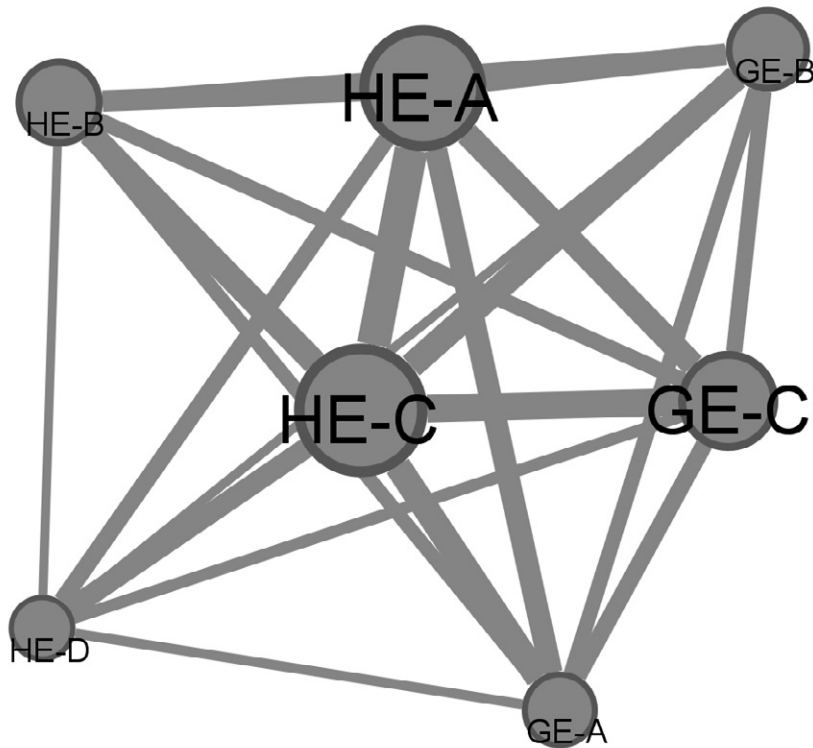


Figure 9. Network of rooms based on shared ceramic functional categories. Nodes represent individual rooms, while edges indicate the co-occurrence of ceramic use types within those rooms. Edge thickness reflects the number of shared functions, and node positioning illustrates the degree of functional overlap across domestic spaces. Gephi software.

use of space or interaction among neighbouring households, potentially reflecting cooperative strategies or shared access to resources within this sector of the settlement. This approach highlights the value of relational models in revealing the organisation of domestic life beyond architectural boundaries.

Network of rooms and ceramic functions

The second network model explores the distribution of ceramic functional categories across domestic units by constructing a bipartite network linking rooms to functional classes (e.g., storage, service, production, ritual) based on co-occurrence data (Figure 8). As with the previous analysis, this two-mode structure was projected into a unimodal network that links rooms sharing at least one functional category, allowing us to trace the spatial distribution and overlap of domestic activities across the settlement (Figure 9).

Within this network, rooms HE-A and HE-C again emerge as central nodes, reflecting their involvement in multiple ceramic functions. The strongest connections are associated with storage-related ceramics, which dominate the network both in terms of number and intensity of links. These rooms appear as multifunctional units with high degrees of functional convergence, likely serving as hubs of domestic storage and redistribution. In contrast, service-related vessels, while widely distributed, produce a sparser network, suggesting more limited overlap in service functions between rooms. Production and ritual ceramics are rare and spatially constrained, with only three and one links respectively across the entire network, highlighting the localised and possibly episodic nature of these activities. This uneven

distribution of functions implies a growing emphasis on storage during Phase 2a, consistent with a broader reorganisation of household economies and emerging patterns of spatial specialisation.

This analysis confirms that by the final occupation phase, domestic units at Capote were increasingly structured around storage needs. The high degree of overlap between rooms like HE-A, HE-C and GE-C suggests coordinated economic practices or shared responsibilities in managing surplus.

Network of vessel types across rooms

The third analytical model reverses the perspective of the previous networks, focusing not on the rooms themselves but on the direct associations between vessel types. Each node represents a distinct ceramic form, and edges indicate co-occurrence within the same room. The goal of this model is to explore patterns of association between vessel types and identify which combinations were most frequently used together, shedding light on activity sets and domestic routines.

To visualise these patterns, we first constructed a co-occurrence matrix and corresponding heatmap (Figure 10), which reveal the frequency with which different vessel forms appear together across rooms. Storage vessels stand out as the most consistently co-present type, frequently associated with serving and preparation forms such as globular jars, lids, and bowls. The co-occurrence network (Figure 11) reveals that storage vessels consistently occupy central positions, exhibiting high degrees of connectivity with a wide range of other forms. Their frequent association with cooking and serving vessels, particularly in rooms such as HE-A, GE-A and GE-B, suggests multifunctional use of space where food storage, preparation and consumption were closely intertwined. These clusters of co-occurring forms likely reflect integrated domestic practices and highlight the relational logic that structured household provisioning.

By contrast, the network also reveals forms with limited connectivity, typically associated with more functionally specialised contexts. The low diversity of vessel forms in rooms such as HE-B and HE-D – dominated almost exclusively by storage vessels – implies a more restricted activity scope, reinforcing their interpretation as dedicated storage units.

This form–form network model complements the insights from previous analyses by shifting focus away from architectural spaces and onto the ceramic assemblages themselves. It reveals that vessel types were not simply distributed randomly across rooms but were embedded in a consistent set of functional pairings that reflect coherent behavioural routines in daily life.

GIS spatial distribution of ceramics

The final stage of analysis explores the spatial distribution of ceramic functional categories across the western sector of Capote through GIS visualisation. Using precise intra-site coordinates, ceramic finds were mapped and colour-coded by function (storage and service/tableware), enabling the identification of functional zones and overlaps within the excavated domestic structures (Figure 12a). This mapping reveals an immediate visual contrast between rooms with multifunctional assemblages and those dominated by storage ceramics. To further explore patterns of activity concentration, Kernel Density Estimation (KDE) was applied separately to storage (Figure 12b) and service ceramics (Figure 12c).

Storage vessels show a marked concentration in rooms GE-A and HE-C, visually reinforcing the patterns previously observed in the room–function network. These concentrations indicate the presence of centralised storage areas, likely serving not only individual households but possibly broader collective needs. Service vessels, in contrast, are more diffusely distributed, overlapping with storage zones in multifunctional rooms. This differentiation supports the interpretation of certain rooms as multifunctional hubs, while others appear more narrowly focused on specific economic tasks.

The spatial configuration observed through GIS reveals an increasing functional segmentation of space during Phase 2a. This pattern likely reflects both evolving household strategies and broader structural

	Bottle	Shallow bowl	Lid	Storage jar	Globular vessel	S-profile vessel	Ovoid vessel	Biconical vessel	Amphora	Patera	Bowl	Discoidal	Plate	Burner	Spindle whorl	Truncated conical vessel	Miniature	Strainer	Funnel	Jug	Oil lamp	Urn
Bottle	2	2	2	2	2	2	1	1	2	0	1	1	1	0	1	0	0	1	1	1	1	1
Shallow bowl	2	5	4	5	5	5	3	2	5	0	4	2	2	2	2	1	1	1	1	1	1	1
Lid	2	4	5	5	5	5	2	2	5	1	3	1	1	1	2	1	1	1	1	1	1	1
Storage jar	2	5	5	7	7	6	3	2	7	1	5	2	2	2	3	1	1	1	1	1	1	1
Globular vessel	2	5	5	7	7	6	3	2	7	1	5	2	2	2	3	1	1	1	1	1	1	1
S-profile vessel	2	5	5	6	6	6	3	2	6	1	4	2	2	2	2	1	1	1	1	1	1	1
Ovoid vessel	1	3	2	3	3	3	3	2	3	0	2	1	1	1	1	1	0	0	0	0	0	0
Biconical vessel	1	2	2	2	2	2	2	2	2	0	1	0	0	0	1	1	0	0	0	0	0	0
Amphora	2	5	5	7	7	6	3	2	7	1	5	2	2	2	3	1	1	1	1	1	1	1
Patera	0	0	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Bowl	1	4	3	5	5	4	2	1	5	0	5	2	2	2	3	1	1	1	1	1	1	1
Discoidal	1	2	1	2	2	2	1	0	2	0	2	2	2	1	1	0	0	1	1	1	1	1
Plate	1	2	1	2	2	2	1	0	2	0	2	2	2	1	1	0	0	1	1	1	1	1
Burner	0	2	1	2	2	2	1	0	2	0	2	1	1	2	0	0	1	0	0	0	0	0
Spindle whorl	1	2	2	3	3	2	1	1	3	0	3	1	1	0	3	1	0	1	1	1	1	1
Truncated conical vessel	0	1	1	1	1	1	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0
Miniature	0	1	1	1	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0
Strainer	1	1	1	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1
Funnel	1	1	1	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1
Jug	1	1	1	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1
Oil lamp	1	1	1	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1
Urn	1	1	1	1	1	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	1	1

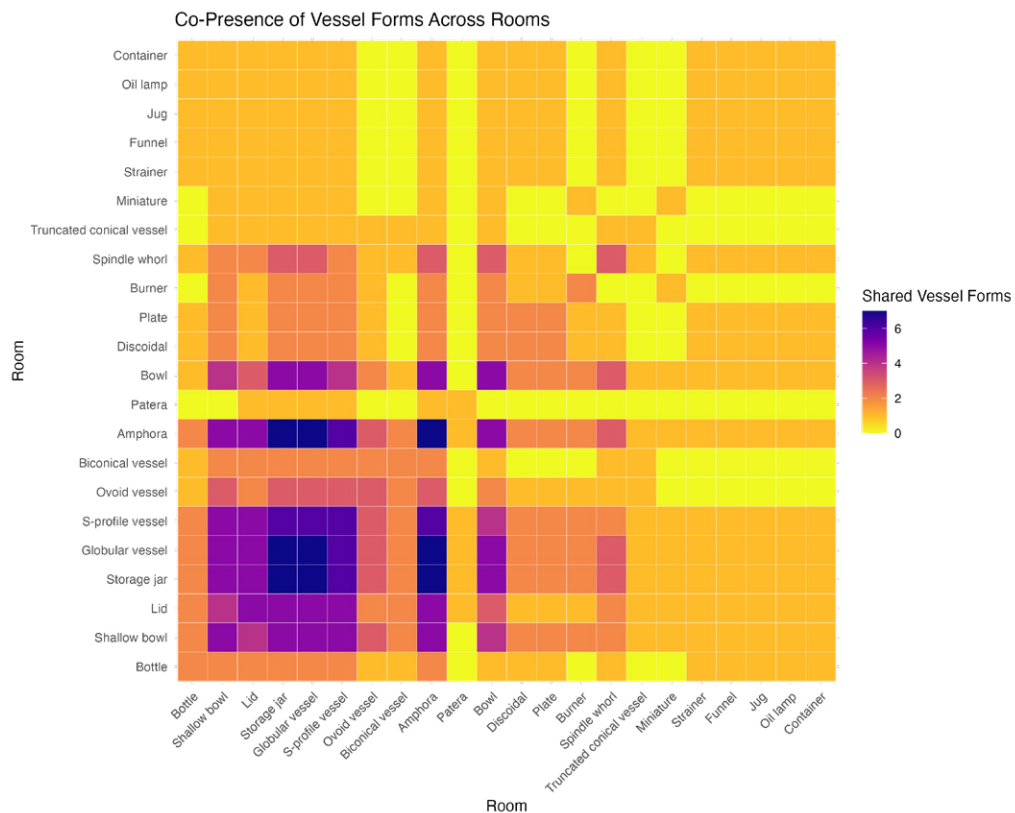


Figure 10. Co-occurrence of ceramic vessel types across rooms. The table displays the number of co-occurrences between each pair of ceramic forms across rooms. The heatmap visualises the same data, with warmer colours indicating more frequent associations between vessel types. Together, these representations highlight functional groupings and recurring activity sets in the ceramic assemblage. R software.

changes linked to Roman influence. The co-location of storage and service ceramics in some rooms may signal shifts in provisioning practices and the reorganisation of domestic routines in response to new socio-political demands.

Discussion: domestic reorganisation and economic strategies in Late Iron Age Capote

The analysis of ceramic assemblages and architectural layouts from Phase 2a at Castrejón de Capote sheds light on how domestic structures were reorganised in response to wider socio-economic and political pressures in the Late Iron Age. This reconfiguration reflects not only local adaptations, but also broader dynamics associated with the settlement's gradual incorporation into the Roman sphere following the conquest. Our integrated network and spatial approach reveals differentiated patterns of household activity, ceramic use and intra-site connectivity that point to emerging inequalities, changing economic strategies and increasingly complex household organisation.

The ceramic networks analysed here suggest a breakdown of earlier models of domestic isonomy. Instead of a homogeneous spatial arrangement and uniform access to resources, we observe diverging household trajectories. Central units such as HE-A and HE-C emerge as multifunctional hubs characterised by dense ceramic networks – both in terms of vessel types and functional categories – implying greater involvement in storage, processing and possibly redistribution. These structures function as nodal points in the internal economic geography of Capote, indicating an incipient hierarchy within the domestic realm. This process mirrors developments in other hillforts during the second and first centuries BCE,

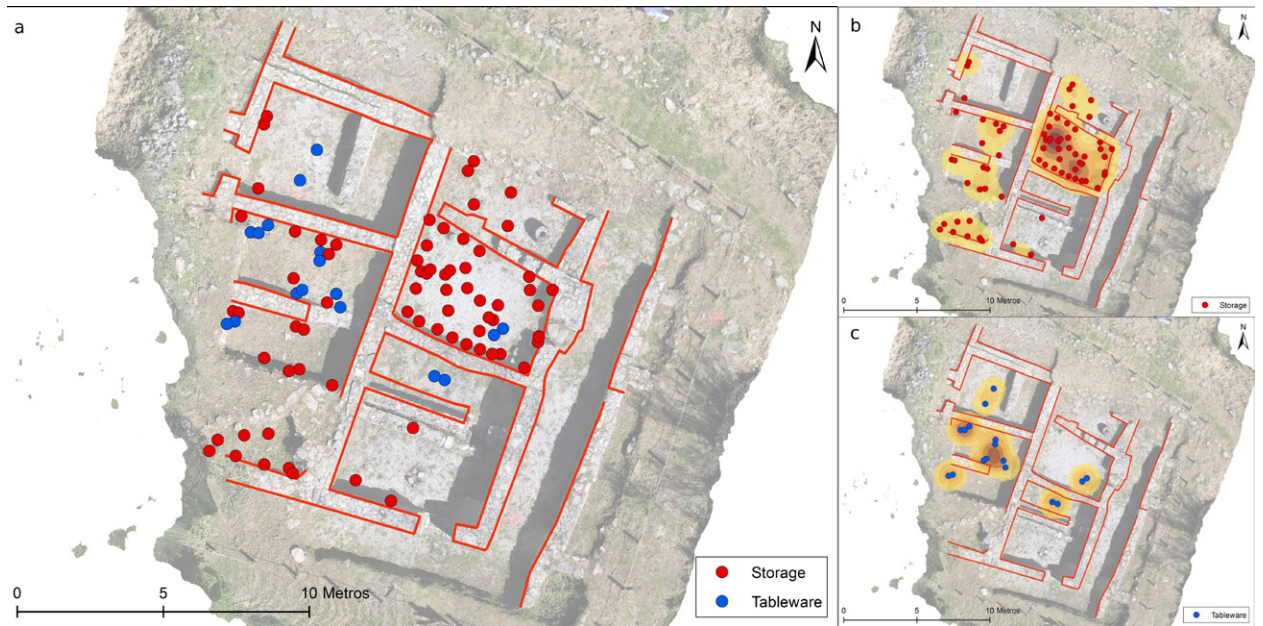


Figure 12. Spatial distribution and density of ceramic vessel categories: a) Raw distribution map of storage (red) and service/tableware (blue) vessels, b) KDE for storage vessels, indicating concentrated zones of provisioning and accumulation, c) KDE for service/tableware vessels. GIS software.

– where participation in wider exchange systems coexists with localised strategies and constraints. These relational dynamics are better captured through a network approach that foregrounds co-occurrence, modularity and spatial correlation, rather than typological abundance alone.

Finally, the Capote dataset reveals how domestic economies were embedded within broader regimes of political incorporation and cultural redefinition. The ceramic networks serve as proxies for understanding how daily life was negotiated in response to external pressures and how material practices – such as storage, processing and consumption – became arenas for the expression of emerging inequalities and adaptations. In this sense, Capote exemplifies how Late Iron Age households were not passive recipients of change but active agents shaping their economic and spatial environments.

Conclusion

The analysis of Phase 2a at the Castrejón de Capote hillfort, using an integrated methodology combining architectural study, network analysis, and GIS tools, offers valuable insights into the sociocultural transformations and spatial reorganization of the settlement – particularly following the historical arrival of Celtiberian groups and the imposition of Roman control around 138 BCE. The findings highlight the emergence of increasingly prominent storage spaces, particularly in units such as HE-A and HE-C, signaling a transition from multifunctional domestic architecture toward units with a strong emphasis on storage. This pattern reflects the gradual erosion of earlier isonomic and egalitarian principles, giving way to a more hierarchical social organization in which certain households began to accumulate and manage surplus resources on a larger scale.

This shift can be interpreted as an adaptive response to the disruptions caused by population movements and the changing political landscape under Roman influence, with the Republican refoundation of *oppida* such as Nertobriga and the integration of this territory into Sertorius' sphere of control during the military front established between 80 and 76 BC. The growing importance of storage – both architecturally and materially – suggests a strategic prioritization of surplus management, potentially linked to provisioning obligations, tribute systems, or participation in broader economic networks. Importantly, this transformation did not entail a complete abandonment of traditional domestic practices. Rather,

the material and spatial evidence points to a coexistence of older forms with emerging economic imperatives, illustrating how domestic architecture became a key arena for negotiating new realities of imperial entanglement.

Building on these results, future research will extend beyond the ceramic assemblages of Phase 2a to include other occupational phases at Capote, as well as additional categories of material culture, such as metal objects, faunal remains, and other artefacts. This diachronic and multi-material approach will help construct a more holistic understanding of the evolution of domestic practices over time. Moreover, the application of more advanced network and GIS techniques – such as multiplex networks with normalized data – will offer refined insights into the relationships between rooms, objects, and functions, ultimately revealing a more nuanced picture of Capote's social and economic organization in the Late Iron Age.

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The ancient horizon in the Iberian world of the region of Murcia. The formation and emergence of a new culture through the reception of Greek pottery

José Fenoll Cascales,¹ Jesús Robles Moreno² and José Miguel García Cano³

Abstract

During the 7th and 6th centuries BC, the first Greek imports arrived in the southeast of the Iberian Peninsula. There are very few materials scattered throughout the geography of the Region of Murcia that bear witness to the first Greek contacts with the cultures of the first peninsular Iron Age. These repeated contacts over time between the local elites and external agents led to the Iberian culture becoming a society fully integrated into a Second Iron Age culture by the end of the 5th century BC or the beginning of the 4th century BC. However, this date for the beginning of the full period of Iberian culture in Murcia is much later than other starting dates in the rest of Spain. This raises the question of why the development of Iberian culture in this region is so late and why the societies of the First Iron Age are practically unidentifiable from those of the Late Bronze Age in the region. However, the imported materials, thanks to their chronotypology, allow us to testify that despite the existence of a series of previous contacts, the peak and turning point in the transformation of the Iberian society occurs around 400 B.C., coinciding with the systematic arrival of Greek products to the area.

Key words: Archaeology, Iron Age II, Iberian Peninsula, Iberian Culture, Greek pottery

Résumé

Au cours des VII^e et VI^e siècles av. J.-C., les premières importations grecques arrivent dans le sud-est de la péninsule Ibérique. On trouve très peu de matériels dispersés dans la géographie de la région de Murcie témoignant de ces premiers contacts grecs avec les cultures du premier âge du Fer péninsulaire. Ces contacts répétés au fil du temps entre les élites locales et des agents externes ont conduit la culture ibérique à devenir une société pleinement intégrée dans une culture du second âge du Fer vers la fin du Ve siècle ou le début du IV^e siècle av. J.-C. Cependant, cette date pour le début de la période de plein épanouissement de la culture ibérique à Murcie est bien plus tardive que les dates de début observées dans le reste de l'Espagne. Cela soulève la question de savoir pourquoi le développement de la culture ibérique dans cette région est si tardif et pourquoi les sociétés du premier âge du Fer y sont pratiquement impossibles à distinguer de celles de l'âge du Bronze final. Néanmoins, les matériels importés, grâce à leur chrono-typologie, nous permettent de témoigner que malgré l'existence d'une série de contacts antérieurs, le point culminant et le tournant de la transformation de la société ibérique se produisent vers 400 av. J.-C., coïncidant avec l'arrivée systématique de produits grecs dans la zone.

Mots-clés: Archéologie, second âge du Fer, péninsule Ibérique, culture ibérique, céramique grecque

Introduction and the question of chronology

Iberian culture was a protohistorical society characteristic of the Iberian Peninsula. This geographical area extended along the Mediterranean coast from southern Spain to southern France, with some penetrations into the interior of the Spanish South Meseta. Chronologically, this culture extends from the 6th to the 1st centuries BC. While its geographical limits seem to be clear, with some discussions on topics such as the 'Turdetanian question'. However, the question of chronology is certainly more complicated, since the beginning, development and end of this culture did not occur homogeneously throughout the territory. Given the difficulty and variability of this event, it is necessary to restrict the field of study to a single region in order to be able to study it in detail. For this reason, this article will focus on the first material evidence dating from the Iberian period in the Region of Murcia (Spain). A place that was undoubtedly one of the most important reception centres of Mediterranean trade during the first millennium BC.

¹ Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid; jose.fenoll@uam.es

² Departamento de Prehistoria y Arqueología, Universidad Autónoma de Madrid; jesusroblesmoreno@outlook.com

³ Universidad de Murcia; jmgc@um.es

It is now generally accepted that Iberian Iron Age extends from 6th century BC to the Change of Era (1st century BC), but its exact chronological boundaries are diffuse, and they differ between the different Iberian regions. An illustrative example is the end of Iberian Culture, it is assumed that the beginning of that end is in the context of the Second Punic War (218–201 BC) which implies Roman settlement on the Iberian Peninsula, and the consequent progressive Romanisation of the native substratum. But this period of two centuries does not mean the end of Iberian culture. Rather, it is the beginning of a time in which, to a greater or lesser extent, and with greater or lesser speed, Iberian culture dissolved into the Roman world until it disappeared completely between the middle and the end of the 1st century BC.

For the beginning of the Iberian world, the lack of definition is even more difficult and interesting, as the same heterogeneity can again be observed. For example, in some points of Andalusia, very early dates are proposed for the establishment of the first *oppida*. Such is the case of Puente Tablas, where the existence of Iberian cultural elements ('urbanism' and the use of potter's wheel) is documented at the very start of the 6th century BC (Ruiz *et al.* 2015: 107). In Albacete, for example, the first clear testimonies of Iberian culture date back to the end of that same century, with evidence such as the orientalising monument of Pozo Moro (490 BC) (Almagro 1983; Robles 2023). But in other Iberian Regions, such as Murcia, it is very complicated to find Iberian cultural elements before the second half of the 5th century BC or even the beginning of the next century (García Cano 1982).

This is the problem that will be explored in this article, because in the current state of knowledge, it is not possible to establish a unique date for the start (nor the end) of Iberian culture. We cannot look for a general rule for the beginning of the Iberian culture, but rather we must analyse each, focusing on the specific site or grouping them into study regions. Thus, in the following paragraphs, we will compile the oldest testimonies in the aforementioned territory in order to try to define the early chronological horizon of Iberian culture and to determine the date of the beginning of it in Murcia.

Throughout the study, the imported materials will be used as a chronological reference as they are the only materials that offer us a certain date. Thus, the Iberian ceramic forms do not have a definite chronology and therefore cannot be used as chronological markers of the Iberian contexts. This does not detract from the fact that some attempts have been made to periodize them for sites with abundant information and imported material linked to Iberian pottery on closed context, such as El Cigarralejo (Cuadrado and Quesada 1989).

Iron Age I in the Region of Murcia

In the nearby region of Alicante, the early Iron Age is presented as a well-defined period thanks to sites such as Fonteta (Guardamar del Segura) (González 2011, 2014; Lorrio *et al.* 2023), Peña Negra (Crevillente) (Lorrio and Torres 2022), El Oral (San Fulgencio) (Abad and Sala 1993, 2001) and Los Saladares (Orihuela) (Lorrio 2019). Thus, the first interactions between the indigenous people and the Phoenicians are well registered both in the material record and in the architectural and technological progress of the civilization.

However, this same period between the end of the Bronze Age and the beginning of Iron Age II is hardly documented in the Region of Murcia. There, in most of the habitat sites, the stratigraphic record prior to the full Iberian period usually corresponds to a Late Bronze Age level or a very unrepresentative level of Iron Age I. This is the case, for example, at Coimbra del Barranco Ancho (Jumilla) (Lillo 1981: 22) or Cobatillas la Vieja (Santomera) (Lillo 1981: 95). There is a time span of almost 400 years in which no occupation is recorded (c. 8th–4th BC).

From the 7th BC century onwards, some evidence of the beginning of the first Iron Age in Murcia began to be recorded, but this was limited to very scarce evidence such as Castelar de Librilla (Cutillas and Ros 2020), Punta de Los Gavilanes (Mazarrón), Cabezo de la Fuente del Murtal (Alhama), Santa Catalina del Monte (Poyato 1976–1978; Ros Sala 1986–1987), the necropolis of Collado y Pinar de Santa Ana (Jumilla) (Hernández and Gil 2001–2002) or the Mazarrón I and II wrecks (Ros 2017). Here the material wealth

and technological progress are not comparable to that of the nearby province of Alicante. Although, for the study of this period in the Region of Murcia, we refer to the recent doctoral thesis by Benjamín Cutillas (2020), who has focused an important part of his research on this subject and has helped to better characterise this period for the territory to which we refer.

The beginning of Iberian culture in Murcia

Some material evidence: The 6th century in Murcia

However, from the middle of the 6th century, the first materials imported from Greek coasts began to arrive in the Region of Murcia. Thus, throughout the Segura River basin, which served as a natural route of penetration to the interior of the peninsula, Greek imports began to be acquired. This is the time when pieces like a fragment of an Eastern Greek vase at the Sanctuary of La Luz, dated at 575–530 BC, appeared (Comino 2015: 460; Rouillard 1995–1996) (Figure 3.1). But retrieved in a ritual context from the 3rd–2nd BC inside the *penetral cavum* of the sanctuary (Lillo 1993–1994: 168). The fragment preserves a female face, which together with the female dedication of the temple may lead us to believe that this piece could be a *Keimelia*, a piece preserved through time for its representation and symbolic valor of being figurative and antique. Also, there are some other fragments of Greek pottery from the late 6th century BC, in particular, two pieces of a Droop-type tall-footed *kylix* that were recovered at Cabezo del Tío Pio (Archena) (García Cano 2003: 252; Olmos 1989) (Figures 3.2 and 3.3). One belongs to the settlement and the other to the necropolis of the *oppidum*. The last one is even attributed to the Rhodes Group Painter 12264 (García Cano 1989b: 373). These black-figure goblets are rare in the peninsula, so it is remarkable that two examples appear at a single site.

However, the most significant piece of the period is undoubtedly the bronze figurine depicting a centaur from Royos (Caravaca de la Cruz, Murcia). A piece that would have formed part of a large imported bronze cauldron. It appeared in Caravaca de la Cruz, in the interior of the Region of Murcia. This piece allows us to document the route of penetration of Greek products between the ports at the mouth of the Segura river at the coast and upper Andalusia (Melgares 1991–1992). However, in recent months, the piece has been interpreted as an Italic production, but maintaining its ancient chronology (Graells 2024). Very close to the Region of Murcia, other important Greek materials have also been documented in this chronology. In less than 10 kilometres from the Region of Murcia, the Itiphallic Satyr from Llano de la Consolación was found. It is a Late Archaic Laconic bronze of Greek manufacture from the end of the 6th century BC (Almagro *et al.* 2021: 179).

At the numismatic level, mention should be made of a possible Lesbos drachm found by chance in the village of Bolbax (Cieza) with a chronology of the 6th–5th centuries B.C. The obverse shows the heads of two bulls facing each other and the tree of life. The reverse has a square with three superimposed triangles with the vertex facing downwards (Lillo *et al.* 1980). The obverse shows the heads of two facing bulls and the tree of life and the reverse has a square with three superimposed triangles with their vertex facing downwards (Lillo 1981: 249–250; Lillo *et al.* 1980).

This period (6th century) is marked by the presence of the first objects of Greek manufacture as the result of commercial transactions of Greek merchants, probably Phoenicians, who began to systematically sail around the southeast peninsular from the middle of the 6th century BC, once the foundation of Emporion in the Gulf of Roses had taken place (García Cano 1989a: 176–182, 2003: 252). But in all cases, the 6th-century pieces that have survived have reached us as isolated, fragmentary testimonies, with no complete examples preserved. Sometimes they have even appeared in very late contexts of use, already very worn, fragmented and previously depreciated. On the other hand, we have the materials but not the specific contexts of use of these objects, in the sense that we have no evidence of the 6th century levels at the sites where these pieces have been recovered. Where did the people who acquired these imports live and bury themselves? This is a question for which we do not have an answer, but which can be asked in the context of this research. What seems clear is that all these few fragments are prestige goods

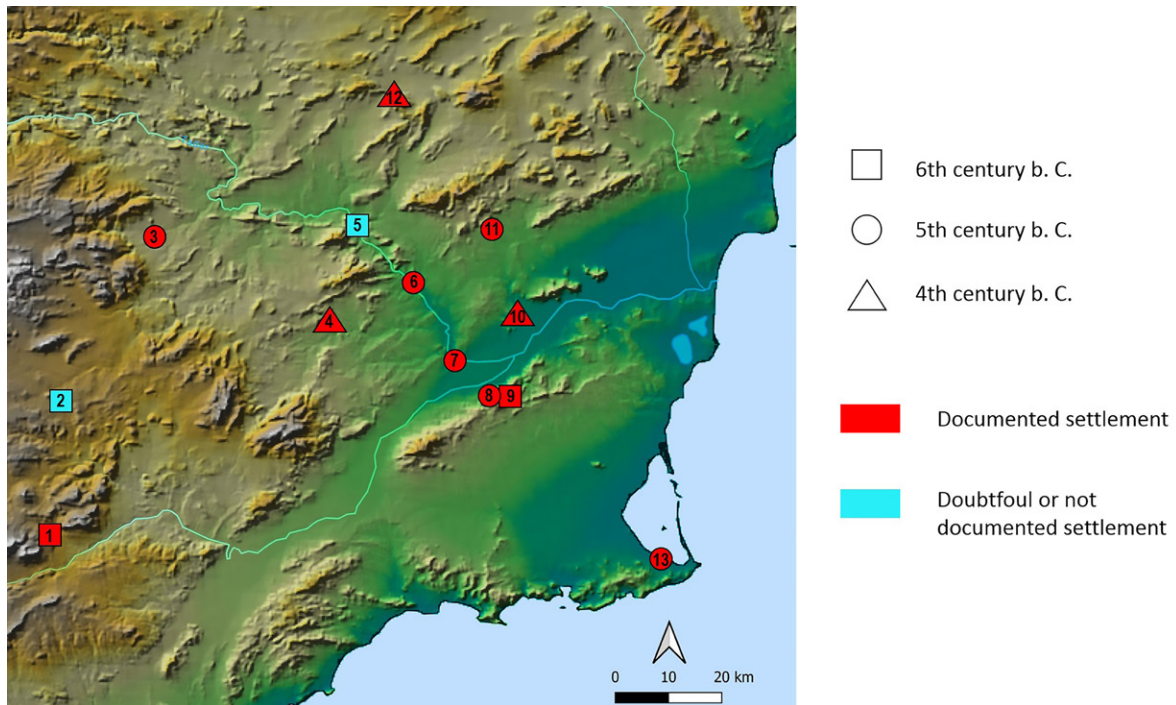


Figure 1. Main sites cited on the text: 1. Necropolis of Calle Corredera (Lorca). 2. Los Royos (Caravaca de la Cruz). 3. Molinicos (Moratalla). 4. El Cigarralejo (Mula). 5. Bolbax (Cieza). 6. Cabezo del Tío Pío (Archena). 7. Cabezo del Agua Salada (Alcantarilla). 8. Cabecico del Tesoro (Verdolay, Murcia). 9. Santa Catalina del Monte (Verdolay, Murcia). 10. Cobatillas La Vieja (Cobatillas). 11. Castillo de los Baños (Los Baños de Fortuna). 12. Coimbra del Barranco Ancho (Jumilla). 13. Loma del Escorial (Los Nietos, Cartagena). (Authors).

resulting from these first and introductory commercial relations, aimed at gaining the confidence of the indigenous ruling elites prior to the commercialisation of Greek manufactures and products on a large scale, once the Hellenic navigators had a relatively precise knowledge of the coasts of Iberia from the last third of the 7th century BC (García Cano 2003: 252) (Figure 1).

Thus, while these first imported pottery vessels were arriving, there were hardly any contemporary Iberian contexts that could have received them. Only a few sites, such as the settlement at Santa Catalina del Monte in Verdolay, record uninterrupted occupation and significant activity during this chronology (Ruiz Sanz 1998).

More Greek imports and the first settlements: The 5th century in Murcia

During the 5th century BC, the last productions of black figures and the first of red figures reached the coasts of Alicante and Murcia. However, the quantity and quality of this production were not yet as high as in the 4th century BC (Garés 2023) (Figure 2).

In this respect, the oldest pieces from the 5th century BC in Murcia have been recovered from important coastal enclaves which served as a centre for redistribution of the material. This is the case of the settlement of La Loma del Escorial (Los Nietos, Murcia), located at the southern end of the Mar Menor; it must have been an important commercial point for coastal trade. In this context, a fragment of a coral-red *kylix* dated in 500–475 BC was found (Trías 1967: 384, no. 1, plate 176, 1) (Figure 3.4) and another *kylix* fragment by the Painter of Bologna 417, dated in 450 BC (García Cano 1997: 138) (Figure 3.5). These two pieces constitute the oldest documents of red figures in the territory that is the subject of this study.

During the second half of the 5th century, imported Greek material is defined by a series of Attic products, mostly tableware, decorated or plain, whose main function is their use in the symposium. Is possible

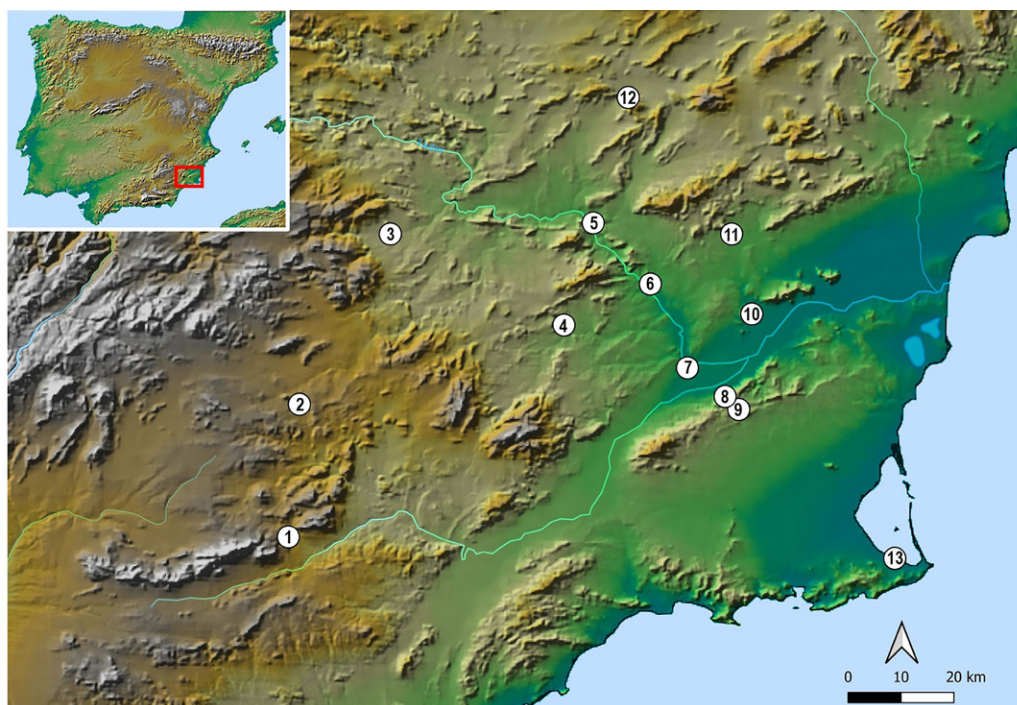


Figure 2. Greek imports in Murcia: 1. Necropolis of Calle Corredera (Lorca). 2. Los Royos (Caravaca de la Cruz). 3. Molinicos (Moratalla). 4. El Cigarralejo (Mula) 5. Bolbax (Cieza). 6. Cabezo del Tío Pío (Archena). 7. Cabezo del Agua Salada (Alcantarilla). 8. Cabecico del Tesoro (Verdolay, Murcia). 9. Santa Catalina del Monte (Verdolay, Murcia). 10. Cobatillas La Vieja (Cobatillas). 11. Castillejo de los Baños (Los Baños de Fortuna). 12. Coimbra del Barranco Ancho (Jumilla). 13. Loma del Escorial (Los Nietos, Cartagena). (Authors).

to distinguish the most common types: *Kylikes-skyphoi* of the Haimon Followers Group in black figures (Figure 3.6 and 3.7); *kantharoi* and *skyphoi* of the Saint Valentin class (Figure 4.4); low-footed *kylikes* of the Delicate I class (Figure 4.5); low-footed *kylikes* with concave lip and internal moulding (*inset lip* from the Agora of Athens), commonly known as Castulo cup by Professor Shefton (Figure 4.7); high-standing Vicup *kylikes* from the Agora of Athens; *skyphoi* of the Attic type adapted from the Corinthian; oinochoes with red figures and black varnish. During this time, there was a scarcity of eating ware, represented only by a few black varnished plates/bowls black outturned rim bowl (F22L/F2681M.) (García Cano 2003: 252–253).

Some of these pieces are the *skyphos* from the Marlay Painter, dated to 430/420 BC, that was recovered from the necropolis of Castillejo de los Baños (Fortuna) (Page 2024). Another example of *skyphos* F3047 was found at burial no. 33 from the necropolis of Calle Corredera in Lorca with a date between 450 and 400 BC (García Cano and Gil 2013) (Figures 3.6 and 3.7). Also, at this time, at Castillejo de los Baños there are some black varnish dishes outturned rim bowl (F22L/F2681M) (Figure 4.1) from tomb 5 with a chronology of the second half of the century (440/430 BC) (García Cano 2003: 253). Also, with red figures and within this chronological horizon is the famous Oinochoe de Alcantarilla, recovered without a precise context in the Calle Cura Hurtado Lorente of the aforementioned locality, but dated to the final years of the 5th century BC or the first of the 4th century BC (García Cano 1982: 50).

As said before, this period of the late 5th century BC is also the date when the last productions of black figures arrived on the peninsula. Continuing with the ancient pieces in the region, in Castillejo de los Baños at tomb no. 20 there is a *kylix-skyphos* of black figures from the followers of Haimon. The grave goods of this tomb also include a bowl with an incurved rim (F21L/F2771M), which, given its morphology, must be dated to between 400 and 390 BC. In Cabezo del Tío Pío, Archena is possible to find a *kylix-skyphos* with black figures attributed to the Painter Haimon with date of 450–400 BC.

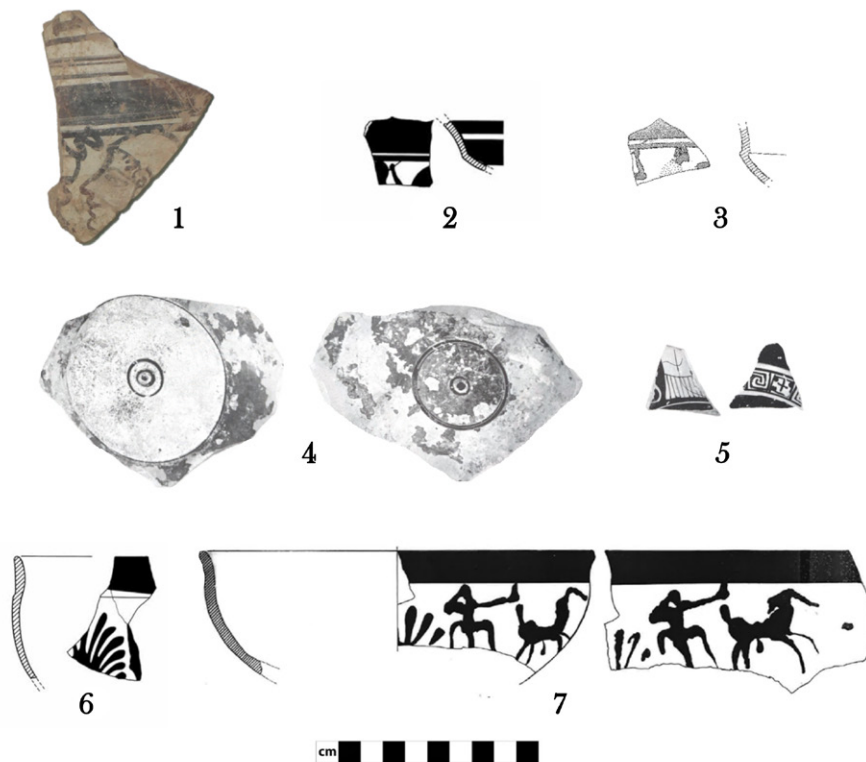


Figure 3. Imported material from 600–400 BC. 1. Fragment of Eastern Greek vase (575–530 BC) Sanctuary of La Luz (Verdolay). 2. Fragment of a tall-footed Droop-type kylix. Painter of the Rhodes Group 12264. Late 6th century BC. Necropolis Cabezo del Tío Pio (Archena). 3. Fragment of a tall-footed Droop-type kylix. Late 6th century BC. Settlement Cabezo del Tío Pio (Archena). 4. Red figures kylix. Painter of Bologna 417. c. 450 BC. La Loma del Escorial (Los Nietos). 5. Coral-red Kylix. 500–475 BC. La Loma del Escorial (Los Nietos). 6. Kylix-Skyphos of black figures. Haimon painter. Second half of the 5th century. Necropolis Cabezo del Tío Pio (Archena). 6. Kylix-Skyphos of black figures. Followers of Haimon. c. 400 BC. Tomb 20 of Necropolis Cabezo del Tío Pio (Archena). Credits: 1.1 Comino 2015; 1.3 Olmos 1983. Authors for the rest.

This chronological period saw the great development of Iberian settlement in Murcia. In fact, for 425–390 BC there are stratigraphic levels with the presence of imported ware at sites such as Molinicos (Moratalla), Cabezo del Tío Pío (Archena), Alcantarilla, La Loma del Escorial (Los Nietos. Cartagena) or closed groups of sites from large necropolises such as Castillejo de los Baños (Fortuna) or Cabecico del Tesoro (Verdolay, Murcia). These finds clearly mark the large areas of Iberian settlement in the region for the first time.

The 4th century in Murcia

From 400 BC onwards, Athenian ceramic wares were received to a greater extent, with a clear predominance of plain, black-glazed tableware: plates, bowls, salt cellars, etc. To a lesser extent, cups and red-figured bell-shaped craters were received. Within this smaller group in terms of quantity, it is possible to find a certain variety, marked by red-figure bell-craters mainly ascribable to the Telos Group, Black Tyrse painters, Oxford Griffomachy or Retorted painter; Low-standing *kylikes* of the Jena Painter and Vienna Group 116 (Figure 5.5); *kylikes-skyphoi* of Painter Q; *skyphoi* of the Fat Boy (Figure 5.10); *arybalistic lekythos*; Late black-varnished and Castulo cup low-standing *kylikes*; Black-varnished *skyphoi* with S-profile (Figure 5.1); Black-varnished *kylikes-skyphoi* (Figure 5.2); Black-varnished *kantharoi* (Figure 5.3) and Bolsales (Figure 5.4). In a much bigger scale appear a group of black-varnished incurving and outturned rim bowls and dishes (F21L./F.2771M. and F.22L./F2681M.) (Figure 5.7 and 5.6); Fish dishes (F.23L./F1121M.) and a

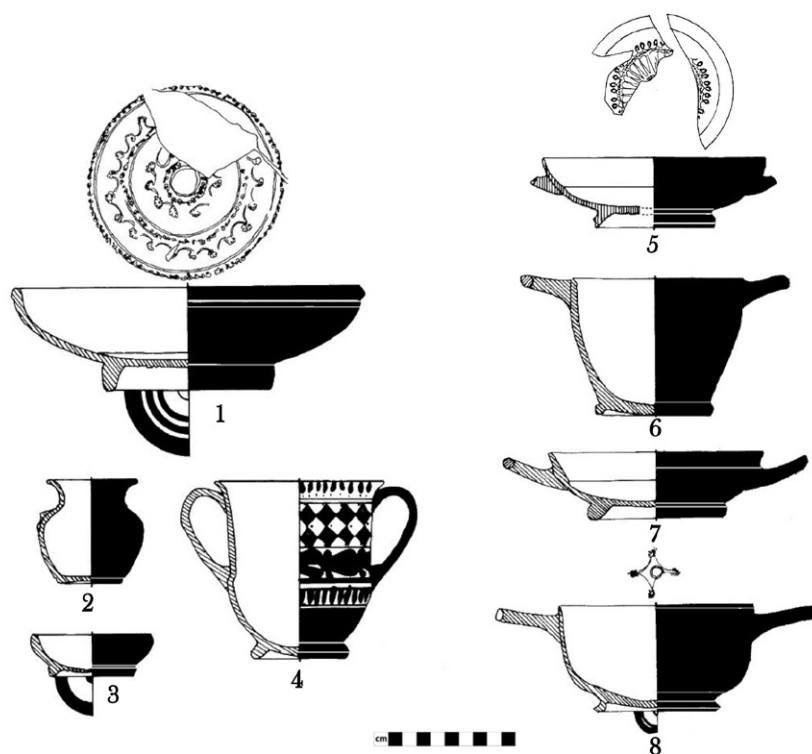


Figure 4. Imported material from 450/425–400/395 BC. 1. Outturned rim bowl (F22L./F2681M.), Necropolis of Castillejo de los Baños (Fortuna). 2. Oinochoe. Necropolis of Castillejo de los Baños. 3. Salero small bowl (F21/25AL./F2761aM.), Necropolis of Castillejo de los Baños. 4. Kantharos from the ST Class. Valentin type IV of Howard and Johnson, Los Molinicos (Moratalla). 5. Kylix of the Delicate Class I. Necropolis of the urban centre of Lorca. 6. Necropolis of Castillejo de los Baños (Fortuna). 7. Kylix inset lip (Castulo cup of Shefton). Necropolis of Cabecico del Tesoro (Verdolay. Murcia). 8. Bolsal. Necropolis del Castillejo de los Baños. (Authors)

large variety of black lacquer saltcellar: Small bowl with broad base (F.21/25BL./F2711M.) (Figure 5.8) and Footed saltcellar (F.24AL./F.2786M.) (García Cano 2003: 253).

Such is the importance of imported ceramics in this period that 64.25% (426 pieces) of the Greek pottery imported into the Region of Murcia falls within the chronological range of 400–350 BC, with a peak in 375 BC (García Cano 1982: 269). The success of the imports would be brief, specifically until the middle of the century, coinciding with the 2nd Roman-Carthaginian treaty of 348 BC, when some settlements such as Ascoy, Cobatillas la Vieja or Molinicos would disappear and imported Greek material would reach others with great difficulty. It was during this same chronology, a wide range of high-quality indigenous pottery appeared in the Iberian potteries, even in the smallest and most distant of settlements, the ‘fine’ Iberian ware appears in the words of Cuadrado (1972). These pieces became part of the domestic and sometimes funerary offerings of the large Iberian centres. Many of these ceramics imitate the most common forms of Attic pottery imported into these regions, mainly plates, dishes and saltshakers for eating and all kinds of cups for drinking, mainly *kylikes*, *kantharoi* and *bowls*. Of the red-figured wares, bell-shaped craters and columns are reproduced (Page 1984, 1987; Page *et al.* 2022). Thus, it seems that the arrival of this Greek pottery on the Murcian coasts represents an important dynamizing change within the native substratum. It was not only the Iberian pottery that changed completely, since the first large settlements and their necropolises appeared at the same time, as we have already mentioned.

This overview clearly illustrates the problem that affects the knowledge of the origins of the Iberian world in Murcia is clear: difficulty in establishing concrete dates in for its beginning. This is due in the

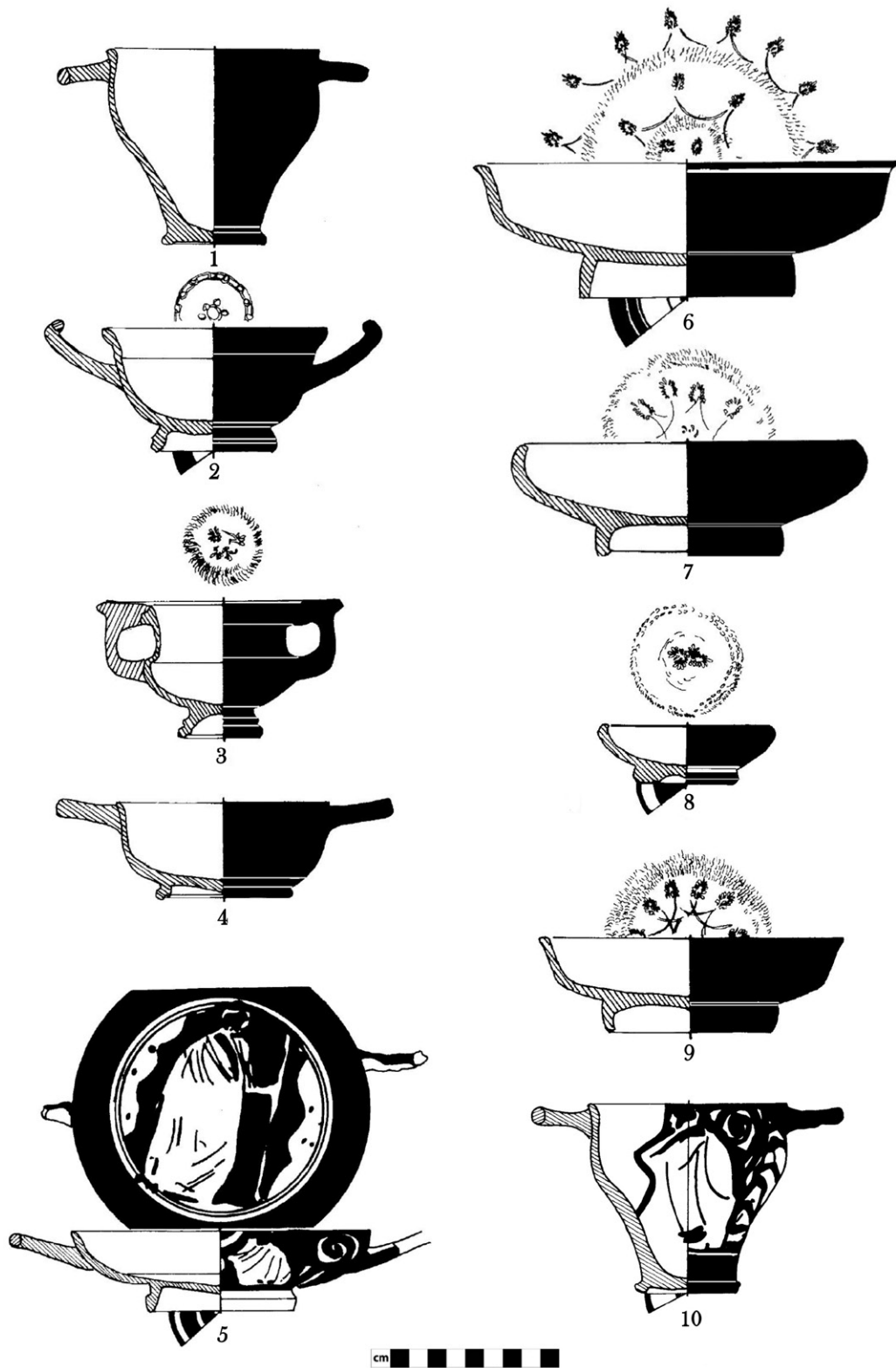


Figure 5. Imported material from 450/425–400/395 BC. 1. Skyphos. Necropolis of Castillejo de los Baños (Fortuna). 2. Kylix-Skyphos. Necropolis of Castillejo de los Baños. 3. Kantharos. Necropolis of El Castillejo de los Baños. 4. Bolsal. Necropolis of El Cigarralejo (Mula). 5. Kylix from the Group of the painter from Viena 116. 6. Fountain bowl with turned rim (F22L./F2681M.). 7. Plato bowl with incurved rim (F21L./F2771M.). 8. Small Salero bowl with wide base (F21/25BL./F2711M.). 9. Bowl with turned rim (F22L./F2681M.). 10. Skyphos from the Fat boy group. n.º 5–10 come from the necropolis of Castillejo de los Baños (Fortuna). (Authors).

first place to the materials we are working with to define this horizon: we are dealing with imported material (Greek pottery), which serves to date very well. But consideration should be given to that there may (or may not) be certain chronological dissonances between the 'original' date of the piece and that of its arrival and use in the Iberian Peninsula. There are certain objects and productions which, as some authors have pointed out, may be *Keimelia* and have a long-life span. This is a fact that has been perfectly studied through the closed contexts offered by Iberian necropolis (García Cano 1999).

The main problem is that there are no Iberian materials that are so diagnostic when it comes to establishing these chronologies. Sculpture has sometimes been used in this respect, appealing to stylistic and formal criteria to date it to very early times (6th–5th BC). However, when this sculpture appears in an archaeological context in Murcia, it is rare for it to be earlier than 400 BC or the last moments of the 5th century BC (Robles and Fenoll 2025: 99–115). Furthermore, as said before it is worth reflecting on the context of the pieces discussed here, since the oldest ones (6th century BC) do not have a precise archaeological context and others come from ritual or funerary contexts, where the presence of symbolic or ritualised objects, such as *Keimelia* or relics, is common.

However, the display of elements beyond the imported materials, such as epigraphy and the use of a Greco-Iberian language found in indigenous areas both on the coast and inland are proof of the intense relations with Greek traders, probably from the northeast quadrant of the Peninsula, which led part of the Iberian oligarchy in the southeast to learn Greek in order to facilitate economic transactions with what this also entailed in terms of influences on the manners and customs that would come to be reflected in different aspects of the daily life of the Iberian societies of the area (García Cano 2003: 261).

In this sense, the beginning of the 4th century BC marks the beginning of the material record during the Iron Age in some important sites such as El Cigarralejo, Cobatillas la Vieja or Coimbra del Barranco Ancho. The only exception would be the Iberian complex of Verdolay, which, despite having a continuous occupation, also underwent a phase of important transformation in which its cremation necropolis appeared at the same time as the rest of the Iberian sites mentioned.

Conclusions

While in other Iberian regions, the beginnings of the Iberian world are clearly defined around the 6th century BC or the beginning of the 5th century BC, this is not the case in Murcia. The archaeological horizon of the 6th century BC in Murcia is defined only by imported Greek ceramics (very few in comparison with other regions) and, in general, is fragmented, decontextualized or used in later contexts. In other words, we know of Greek products that reach the Murcian Iberian world, but nothing or almost nothing of the contemporary to them. Only a few tombs or settlements from the 6th century BC or the beginning of the 5th century BC can be dated. However, the Iberian material culture of this period is radically different from that which would appear from the 4th century BC onwards.

Thus, both in the large settlement and burial sites, the oldest levels correspond to the early 4th century, as can be seen in the Coimbra del Barranco Ancho, La Loma del Escorial, Cigarralejo, Molinicos, Cabezo del Tío Pio and Cobatillas la Vieja. In other words, from this time onwards, the Iberian culture in Murcia was clearly defined. Does this mean that in the 6th century BC there were no Iberians in Murcia? Of course, there was an indigenous population settled in places such as Castelar de Librilla, Punta de los Gavilanes or Santa Catalina del Monte, where a few imported pieces must have arrived, although on many occasions these have come down to us decontextualised or with problematic contexts, which means that they do not allow for a complete panoramic view. On the other hand, the scant documentation of the indigenous population of the 6th century BC shows profound differences in terms of the material record in comparison with those of the 4th century BC, as if they were two cultures, with different technological processes and a completely different social and cultural structure.

There is therefore no continuous line of settlement and evolution that we can follow between the 6th and 4th centuries BC, but rather a strong disruption marked at the end of the 5th century BC, when, with

the arrival of Greek material, the indigenous substratum became more dynamic and developed in a way never seen before. It was at this time, coinciding with full Greek contact, that Iberian culture as we know it began in the Region of Murcia, with its *oppida*, sanctuaries and its necropolis of cremation. Some signs of identity will then appear, such as the fine Iberian pottery made on the Iberian potter's wheel or the offensive weapon par excellence in the Iberian world, the *falcata*, which is in fact derived from the Greek *makhaira* or *kopis* (Quesada 1991).

So it seems that there are two events occurring at the same time in this region of south-eastern Spain. On the one hand, for the first time, the indigenous population had the economic capacity to acquire pieces imported from foreign markets uniformly and in large volumes. In other words, these pieces were arriving on the peninsula at a time when the Iberian pre-monetary economy had sufficient agricultural surplus to acquire the luxurious Greek pieces. Although imported material had already arrived in the previous centuries as shown above, it was very scarce. Nevertheless, these ancient pieces and the first commercial contacts between foreigners and Iberians during the 5th century BC must have been one of the main driving forces for the appreciable change towards the end of that century and the beginning of the next. This materially scarce but constant and prolonged contact with external agents seems to be what finally led to an unprecedented development in the Iberian culture of Murcia. Among the factors to be studied, there must have been a notable evolution in agricultural production, perhaps ultimately derived from the introduction of new techniques for the cultivation of cereals. This, closely linked to a better knowledge of iron forging and therefore the production of tools, is what led the Iberian culture to emerge and fully develop around 400 BC in Murcia. It is then that this knowledge brought from other parts of the Mediterranean over the course of a century and a half will fully permeate the local population, be taken on board and used for the full development of their own culture and identity. In other words, we are looking at a time between 400 and 350 BC when, with the maximum expansion of continental Greek trade, a Greco-Iberian writing system and an Iberian sculpture ultimately derived from Attic and Ionian models emerged in the southeast of the Iberian Peninsula. This, together with the previous knowledge and improvement of the rapid pottery wheel, the location of the oppidum at high altitudes and the configuration of burial necropolises, led to the Second Iron Age being definitively established for the Murcian Iberian world at the aforementioned dates. This process is like the one described by Vives-Ferrandiz for this same process a few centuries before for the Phoenician commerce in the southwest of Spain:

The complexity of the processes of interaction between indigenous and Phoenicians goes beyond the concept of acculturation as a unilateral transformation of indigenous cultures; it is rather a complex process in which the consumption of Phoenician-type material culture does not imply the adoption of a Phoenician behavioural pack. What is necessary is taken by selecting from what is available, because it contributes to reinforcing one's own identity expression, i.e. imports must be seen in the process of local change. The key to a new approach is to consider that some groups, initially indigenous and Phoenician, had needs, consumption, resistance or adaptation objectives, and that they could use a selected material culture for those objectives (Vives-Ferrándiz 2005: 225).

Thus, it seems clear that the development of Iberian culture in the 4th century BC is the result of the repeated and continuous presence of foreign agents with their agricultural knowledge and their close contact with the local elites in search of mutual benefit. It is in this process that the societies of the early Iron Age in Murcia were transformed into a fully-fledged Iberian culture. This represents an absolutely substantial change in the material record, as has already been indicated above. However, it should not be overlooked that the effect that is possible to appreciate here: the early Iron Age in Murcia is not as well characterised as it should be. This leads us to appreciate the radical change that has been emphasised throughout the article. Perhaps some materials that we now identify as Late Bronze Age actually belong to Early Iron Age societies, but the poor characterisation of this period in Murcia has prevented us from defining them as such. This would explain, for example, the time lapses of occupation in the stratigraphy of the sites studied. However, if one thing seems clear, the material imported during the first half of

the first millennium is certainly scarce, which also prevents many of the ancient contexts from being accurately dated.

In any case, there is a clear idea that runs through this work. Be that as it may, the beginning of the second half of the first millennium BC in the region of Murcia is marked by direct and continuous contact with a series of Mediterranean agents, who in cooperation with the local elites and with the introduction of new techniques throughout the 5th century BC (quick lathe, agricultural and livestock improvements...) will eventually lead to the emergence of a new culture fully defined around 400 BC.

This allows us to emphasize, once again, the enormous chronological heterogeneity in the Iberian world, sometimes with centuries of difference in its formative process. Moreover, it allows us to continue delving into the Murcian question and to focus on new questions such as: Why does Iberian culture seem to crystallize so late in this region, when in other adjacent regions it is much earlier? What factors motivate and sponsor this later development? And above all, what is the formation process like? Only new excavations and reinterpretations of old data will be able to shed new light on the great problem of the chronology of the formation of the Iberian world in general and in the Region of Murcia in particular.

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Le dinamiche preistoriche dell'entroterra della Sicilia occidentale legate al Mediterraneo

Angelo Vintaloro¹

Abstract

The first anthropisation of the territory is recorded with the advent of the Neolithic (c. 7500 years ago), as tribes became sedentary. However, human presence in this area increased significantly during the Eneolithic, beginning with the sites of Contrada Giacomobello, located in the lower area and adjacent to what would become the great protohistoric city of Montagna Vecchia; Pizzo Nicolosi, along the Palermo-Agrigento route, and Contrada Pietralunga. The latter was a major commercial hub serving as a hinge between the sea and the hinterland, marked by a natural peak that signalled its mercantile character. The extensive anthropisation of this specific area of the western Sicilian interior was facilitated by the long-distance route connecting North Africa and Southern Europe (identified with southern France and the Italian Ligurian coast), which reached its peak frequency during the Bell Beaker period. The Metal Ages on the island were characterised by numerous cultures settled in macro-areas, often non-contiguous; the Castellucciano culture was predominantly established in eastern Sicily, while the Naro-Partanna and Rodì-Tindari-Vallélunga cultures, alongside the Bell Beaker phenomenon, occupied central and western Sicily. The continuous movement of specialised craftspeople between various centres resulted in cultural variety, evidenced by vascular variants or the coexistence of different facies within the same territory. Current research into the Mycenaean presence in this area has confirmed its widespread occurrence across various sites, including structures linked to cult practices. Notable in the Iron Age was the arrival of peoples from the Italian peninsula; the Sicels invaded western Sicily, displacing the Sicani towards the west, while the Ausonians occupied the Peloritani area and the Aeolian Islands. The Elymians, a people of unknown origin, settled in the north-western area of the island.

Key words: Neolithic, Anthropisation, Mediterranean trade, Mycenaeans, Bell Beaker

Sommario

E' con l'avvento del Neolitico (intorno a 7500 anni fa), quando le tribù divennero stanziali, che si registra la prima antropizzazione del territorio, ma è con l'Eneolitico che aumenta la presenza umana in quest'area, a cominciare dai siti di Contrada Giacomobello, situato nella parte bassa e contiguo a quello che poi divenne, nella protostoria, la grande città di Montagna Vecchia, dal sito di Pizzo Nicolosi, lungo la direttrice Palermo-Agrigento, e di Contrada Pietralunga, grande sito commerciale che rappresentava la cerniera tra il mare e l'entroterra e che presentava l'emergenza naturale del grande pizzo che segnalava la presenza di un sito a carattere commerciale. La grande antropizzazione del territorio, in questa particolare zona dell'entroterra della Sicilia occidentale, avvenne grazie alla lunga via di collegamento nord Africa/sud Europa, quest'ultimo si identificava con la Francia meridionale e la costa ligure italiana, che raggiunse il suo picco di frequentazione durante il Vaso Campaniforme. L'età dei metalli nell'isola fu formata da tante culture stanziate per macro-aree, anche non contigue e talvolta distanti tra loro, con il Castellucciano che si insediò prevalentemente nella Sicilia orientale e le Culture di Naro-Partanna e Rodì-Tindari-Vallélunga, assieme al Campaniforme, nella Sicilia centrale ed occidentale. Il continuo trasferimento di artigiani specializzati nei vari centri, portò anche una varietà culturale fatta di varianti vascolari oppure di una promiscuità di facies tutte all'interno di un territorio. E' allo studio la presenza micenea di quest'area, che nuove acquisizioni hanno confermato essere prevalentemente presente in vari punti, anche con strutture legate al culto. Di rilievo nell'età del ferro, l'arrivo di genti dalla penisola che invasero con i Siculi la Sicilia occidentale cacciando i Sicani verso l'area occidentale e con gli Ausoni che occuparono la parte dei Peloritani le Isole Eolie. Gli Elimi, popolo di cui si sconosce la provenienza, si stanziò nell'area nord-occidentale dell'isola.

Parole chiave: Neolitico, antropizzazione, commercio mediterraneo, Micenei, Campaniforme

Il territorio in questione è posizionato nella parte centro-occidentale dell'isola ed ha avuto un'importante dinamica antropizzante nel corso della più antica preistoria. Per conoscerlo bisogna spingersi fino alle prime fasi della sua frequentazione, confrontata con il resto dell'isola, che presenta dinamiche continue ed incessanti e questo, con somma sorpresa anche del compianto Sebastiano Tusa, con cui lavorai per 27 anni, costituì un fatto nuovo nel panorama archeologico siciliano.

¹ Museo civico Pippo Rizzo; museocorleone@gmail.com

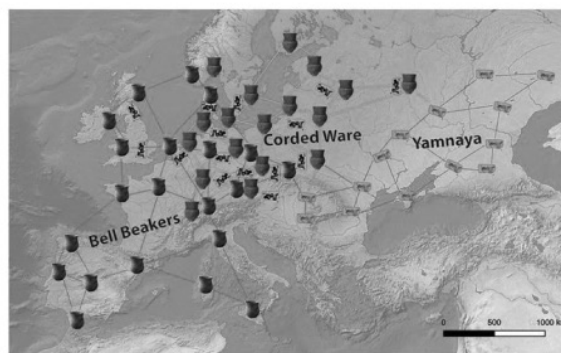


Figura 1. Il Mediterraneo con i paesi che ebbero i rapporti più significativi a partire dall'Eneolitico.

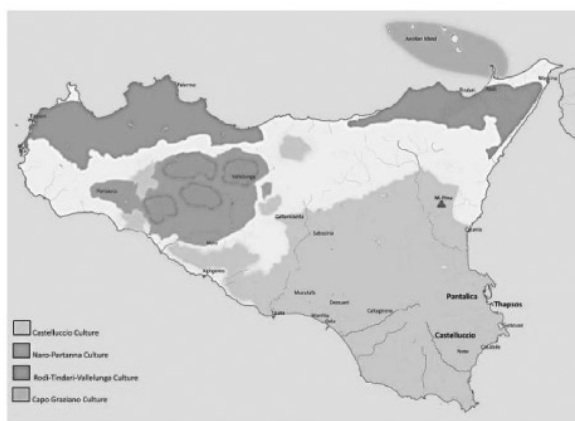


Figura 2. Le Culture Eneolitiche siciliane (a sinistra), probabile fase iniziale della penetrazione neolitica in Sicilia (a destra).

In questa area la presenza più antica è quella del Paleolitico/Mesolitico (12.000–10.000 anni fa circa) ma è con l'avvento del neolitico (7500 anni fa circa), quando le tribù diventavano stanziali, che vi è la maggiore presenza umana in questa importante area. Ampliarono la fase di espansione abitativa di questo entroterra e costituirono la rampa di lancio delle Facies successive di Serra d'Alto e Diana che ebbero una notevole crescita socio-economica legata al commercio dell'ossidiana proveniente dalle Isole Eolie e da Pantelleria.

Si ebbe un nuovo incremento demografico (5400 anni fa circa) legato ad una scarsa ceramica indipendente zona per zona con superficie di colore bruno e ciò si protrasse per tutto l'eneolitico medio con la Cultura di Serraferlicchio probabilmente legata a quella delle Madonie. E' la fase finale dell'eneolitico che rilancia quest'area anche con l'utilizzo delle tombe a forno e tale crescita, anche demografica, continuò per tutta l'età del bronzo e la successiva età del ferro.

Una grande linea commerciale di questa area era quella che collegava il nord-Africa al sud della Francia/Liguria attraverso la mediazione delle isole Sicilia, Sardegna e Corsica e passante per l'area del Corleonese, unico punto di aggiramento del massiccio della Rocca Busambra. Questo segmento era il più importante snodo commerciale che probabilmente generò anche altre Culture o Stili che ci riportano a frammenti ritrovati a Pizzo Pietralunga e che sono in fase di approfondimento scientifico.

La novità, su cui iniziò a credere anche Sebastiano Tusa, era una certa influenza Micenea che non si fermò nella cuspide sud-orientale dell'isola e nell'agrigentino, bensì arrivò nella nostra zona lungo la via



Figura 3. Tomba della Cultura Eneolitica di Castelluccio.

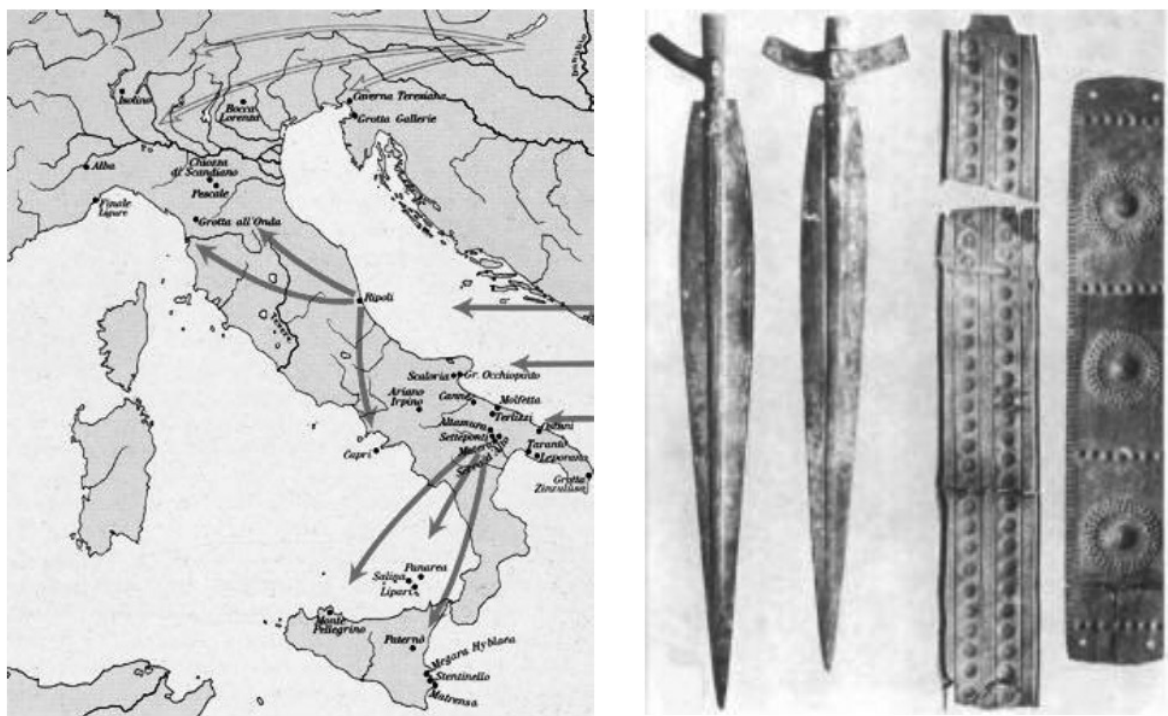


Figura 4. Penetrazione neolitica in Sicilia (a sinistra), armi bronzee (a destra).

sopradescritta. La presenza a distanza molto ravvicinata degli insediamenti importanti, ci autorizza a pensare ancor di più che tra di esse vi sia una diacronia piuttosto che una sincronia con molti insediamenti di impronta castellucciana.

L'incremento vertiginoso della presenza antropica è dovuta alla grande ricchezza ed allo sfruttamento agro-pastorale del territorio. Si tratta di un processo di adattamento all'ambiente collinare e montuoso della Sicilia che, al pari di altre zone dell'isola, anche qui nel Corleonese ebbe grande successo a giudicare dalla capillare distribuzione dell'insediamento.

Con l'antica età del bronzo diventa chiara la polarizzazione intorno a siti con funzione di egemonia funzionale, tutti posizionati nell'entroterra, nelle montagne Sicane. Nell'età del bronzo il territorio



Figura 5. Vaso neolitico della Cultura di Serra d'Alto (a sinistra), ceramica della Cultura di Castelluccio (a destra).

si sviluppò attraverso il modello del Chiefdom, indipendente l'uno dall'altro, da cui si generarono i 'Principati'.

Le Culture preistoriche sono quelle tipiche della zona ma si tratta di rinvenimenti di superficie attraverso un Survey svolto a macchia di leopardo data la vastità del territorio, tuttavia un tipo di ceramica appare del tutto nuovo e quindi merita un approccio ed uno studio diverso mentre il Campaniforme presente in zona, pare quello tipico della Sardegna, che però arrivava dalla Spagna.

L'approssimazione con la quale l'ambito Rodì-Tindari-Vallelunga appare trattato rispetto alle coeve culture di Castelluccio e Capo Graziano (ben più note grazie a estese ed efficaci campagne di scavo e/o di ricognizione) rende importante l'analisi delle sue evidenze e della sua cultura materiale per chiarire le dinamiche del popolamento che hanno interessato la Sicilia nel Bronzo Antico, e che hanno portato al fiorire della cultura Thapsos-Milazzese nel Bronzo Medio.

La facies del Campaniforme interagisce in Sicilia con le locali culture di Malpasso, Sant'Ippolito e Naro-Partanna tra la fine del III millennio ed i primi secoli del II millennio a. C., soprattutto nella Sicilia occidentale. Appare verosimile che lo stile più ricco di elementi tipici delle culture siciliane preesistenti possa essere quello che perduri più a lungo fino ad essere contemporaneo con la facies di Partanna e Naro, variante occidentale della grande civiltà di Castelluccio (Veneroso 1994).

La diffusione del complesso culturale del Bicchiere si accentra soprattutto in due aree della Sicilia occidentale: una settentrionale ed una meridionale. Nell'area nord-occidentale notiamo la presenza di molti esemplari di Bicchiere e, soprattutto, un'estesa diffusione degli schemi decorativi tipici realizzati con la tecnica del pointillé,

La ricerca ultima si prefigge anzitutto di definire Rodì-Tindari-Vallelunga dal punto di vista culturale, necessità che prende l'avvio dalle recenti prese di posizione sopra descritte, sulla possibilità che Rodì-Tindari-Vallelunga non sia una vera e proprio 'cultura', alla stregua di Castelluccio e Capo Graziano, ma qualcosa d'altro, variabile tra uno 'stile ceramico' ed un prototipo della produzione 'thapsiana'.

Trovo ragionevole a questo proposito la proposta dell'amico Talamo, che in merito alle affinità tipologiche tra Mezzano, Palma Campania, Capo Graziano e Rodì-Tindari-Vallelunga parla di '(...) tradizioni culturali distinte, che si sviluppano in modo parallelo, mediante una forte e diffusa permeabilità culturale,

policentrica e multidirezionale', nella quale 'un ruolo notevole hanno di certo le componenti mediterranee, eoliane e maltesi attive ad ampio raggio'.

Sul piano culturale, lo studio delle presenze maltesi in Sicilia ha colmato un vuoto non solo nella storia dell'interrelazione socio-culturale siciliano-maltese ma soprattutto nel quadro della definizione dell'importanza che l'elemento allogeno ha rivestito nell'evoluzione della cultura indigena nell'età del Bronzo Medio.

Se da un lato, sulla base delle più recenti ricerche, è stato riconosciuto alle influenze cipriote e micenee il cosiddetto fenomeno di miceneizzazione, dall'altro lato ha comunque il merito di aver contribuito, in modo sostanziale, all'acquisizione di consapevolezza di unità etnica da parte degli indigeni (sicanità) attraverso l'ingresso socio-politico delle comunità verso forme più complesse.

Ma la perfezione tecnica delle forme della cultura micenea rispetto a quella maltese ed il loro contemporaneo palesarsi all'osservatorio della Sicilia indigena ha verisimilmente impedito che si innescasse, nella cultura di Thapsos, un analogo meccanismo di emulazione nei confronti di quella maltese di Borg-in-Nadur. Tanto più che il livello di complessità culturale delle genti di Borg-in-Nadur doveva essere molto più vicino agli standards thapsiani.

Sebastiano Tusa attesta e conferma che nell'area centro-meridionale e meridionale della Sicilia (che va dall'Ennese, e vi ricomprendiamo almeno parte del territorio dell'odierna Gangi, dove vi è la presenza di una forte componente sicana in rapporti col mondo minoico e miceneo.

Il II millennio a. C. vede nella Sicilia occidentale il dispiegarsi di diverse culture e tradizioni a volte contemporanee tra loro. Pur diffondendosi la cultura di Castelluccio nell'Ovest dell'isola essa presenta caratteri peculiari e si evolve rapidamente verso quell'aspetto definito Rodi Tindari Valledlunga che ormai tendiamo ad assimilare ad un processo di sviluppo verso la successiva facies thapsiana.

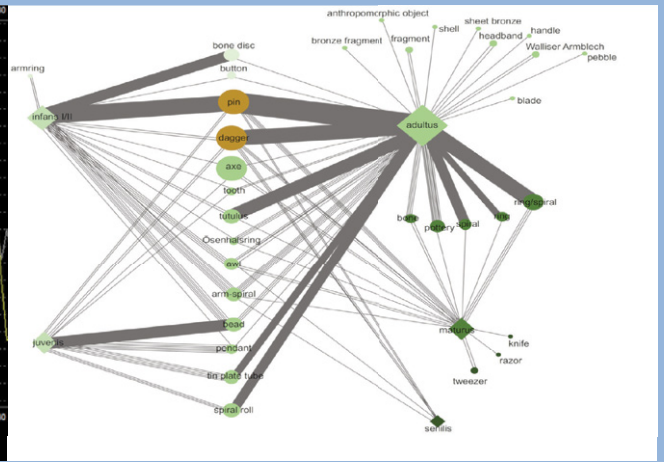
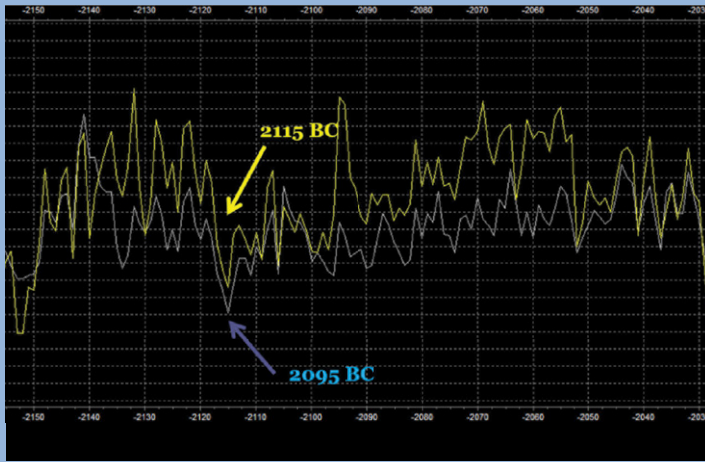
Diffusa ampiamente nel territorio occidentale questa facies fa già intravedere alcune sottili ma sensibili differenze culturali tra gli aspetti tirrenici e quelli più continentali legati al territorio siciliano ed al Canale di Sicilia.

La Sicilia si inserì dunque nel circuito commerciale mediterraneo monopolizzato dai micenei nel II millennio a. C., come testimonia, ad esempio, l'insediamento a Monte Grande di Palma di Montechiaro, e l'approdo di Cannatello, nell'entroterra della costa orientale di Agrigento. Area che costituiva la parte finale (o iniziale) del percorso verso l'attuale zona del palermitano, mediato dall'area corleonese, e che rappresentava uno dei percorsi principali dell'isola, perché collegava le due coste. La guerra tra Cretesi e Sicani di Camico, posto a S. Angelo Muxaro, vide la città Sicana resistere ad oltranza ed i cretesi, esausti, abbandonare le postazioni e rifugiarsi nel centro della Sicilia, fino a Gangi nell'area delle Madonie. E' facile dedurre che se arrivarono nelle Madonie molto più facilmente, perché più vicino e più ricco di risorse naturali, potevano stanziarsi nelle altre varie parti della Sicilia occidentale, vero punto di snodo dei traffici marittimi e terrestri.

Nell'età del ferro, furono tante le popolazioni che si stanziarono in Sicilia, tra cui gli Ausoni nell'area nord orientale, provenienti dal continente, e gli Elici che popolarono la parte occidentale dell'isola, e che provenivano dalla distruzione di Troia oppure dalla Liguria con cui la Sicilia conduceva notevoli scambi commerciali fin dal neolitico. Un ruolo importante lo svolsero gli Shekelesh, che facevano parte della confederazione dei Popoli del Mare e che appare anche nelle fonti scritte egizie durante il Nuovo Regno.

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Making and Meaning in the Bronze and Iron Ages brings together a wide-ranging selection of papers from the METALAGES2024 colloquium, offering new perspectives on chronology, material culture, and social life across prehistoric Europe and the Mediterranean. While grounded in the technical challenges of chronological research, this volume moves beyond dating frameworks to explore how time, production, and meaning intersect in archaeological interpretation.

Contributors engage with cutting-edge methods – including radiocarbon dating, dendrochronology, Bayesian modelling, and isotopic analysis – while critically examining their integration with typological sequences and regional cultural schemes. These studies demonstrate that chronology is not merely a technical tool, but a dynamic field that shapes our understanding of human agency, cultural interaction, and historical change.

At the same time, the volume reflects the diversity of current research in the Bronze and Iron Ages. Case studies span settlement networks in Ireland and northern Britain, dendrochronological sequences in Italy, and fortified landscapes in Central and Western Europe. Other contributions address gender, personhood, craft production, and long-distance connections in Mediterranean societies, highlighting the interplay between material practices and social meanings.

By bringing together methodological innovation and interpretative insight, this collection captures the collaborative and interdisciplinary spirit of the METALAGES series of international colloquia, organized by the UISPP Scientific Commission *Metal Ages in Europe and the Mediterranean*. It offers an essential resource for scholars interested in the evolving relationships between chronology, landscape, and society in later European prehistory.

Lucía Ruano Posada is a postdoctoral researcher at the University of Lisbon (UNIARQ), specialising in Iron Age and later prehistoric archaeology of the Iberian Peninsula. Her research focuses particularly on domestic architecture, household organisation, earthen building technologies, and the socio-technical dynamics of settlement spaces, drawing on geoarchaeology, ethnoarchaeology, archaeometry, and spatial analysis. She has contributed actively to international scholarly networks and UISPP activities, including the organisation of conference sessions and edited publications.

Dirk Brandherm is Reader in Prehistoric Archaeology at Queen's University Belfast, specialising in the Chalcolithic, Bronze and Iron Ages of Atlantic Europe and the Mediterranean. His research addresses later prehistoric social change, chronology and scientific dating, metallurgy, and the archaeometric study of material culture, with a particular interest in exchange and connectivity. He has led and contributed to numerous international collaborative projects and currently serves as President of the UISPP Metal Ages Commission.

Luis Berrocal-Rangel is Professor of Prehistory at the Autonomous University of Madrid, where he also serves as Head of the Department of Prehistory and Archaeology. A leading specialist in Iberian Iron Age and Hispano-Celtic archaeology, his research encompasses settlement archaeology, protohistoric architecture, fortified landscapes, identity, and cultural interaction across Iberia. He combines extensive fieldwork with broader theoretical perspectives on social complexity and has long been involved in international research collaborations and UISPP initiatives.

