

Open Access Annual Journal

a1d

Archeo
Logica
Data

N° 5.2 – 2025



ArcheoLogica Data

Open access *Annual Journal*

Editors

Francesca Anichini (Dipartimento di Civiltà e Forme del Sapere – Università di Pisa)
Gabriele Gattiglia (Dipartimento di Civiltà e Forme del Sapere – Università di Pisa)
Maria Letizia Gualandi (Dipartimento di Civiltà e Forme del Sapere – Università di Pisa)

Scientific advisory board

Valeria Boi (Istituto Centrale per l'Archeologia – Ministero per i beni e le attività culturali e per il turismo)
Philip Buckland (MAL- Environmental Archaeology Laboratory – University of Umea)
Stefano Campana (Dipartimento di Scienze Storiche e dei Beni Culturali – Università di Siena)
Francesco Carrer (School of History, Classics and Archaeology – University of Newcastle)
Carlo Citter (Dipartimento di Scienze Storiche e dei Beni Culturali – Università di Siena)
Elisa Corò (Venice Centre for Digital and Public Humanities – Università Ca' Foscari Venezia)
Nicolò Dell'Unto (Department of Archaeology and Ancient history – University of Lund)
Beatrice Demarchi (Dipartimento di Scienze della Vita e Biologia dei Sistemi – Università di Torino)
Anna Foka (Department of archives, museums and libraries – University of Uppsala)
Francesca Grassi (Dipartimento di Scienze Storiche e dei Beni Culturali – Università di Siena)
Matteo Lorenzini (Independent researcher)
Vera Moitinho de Almeida (Institute for the Study of Ancient Culture, Austrian Academy of Sciences IKAnt-ÖAW)
Marco Nebbia (Institute of Archaeology – University College London)
Hector Orenge (Catalan Institute of Classical Archaeology)
Augusto Palombini (CNR- ISPC)

Herman Salvadori (Independent researcher)
Anna Maria Stagno (Dipartimento di antichità, filosofia e storia, Università di Genova)
Elisabetta Starnini (Dipartimento di Civiltà e Forme del Sapere – Università di Pisa)
Holly Wright (Department of Archaeology – University of York)
Chiara Zuanni (Austrian centre for digital humanities – University of Graz)

Editorial board

Salvatore Basile (Dipartimento di Civiltà e Forme del Sapere – Università di Pisa)
Antonio Campus (Scuola Normale Superiore, Pisa)
Chiara Giovannetti (Dipartimento di Scienze dell'Antichità – Università di Roma "La Sapienza")
Alessandro Panetta (ISEM – CNR)
Filippo Sala (Dipartimento di Ingegneria Civile e Industriale – Università di Pisa)
Claudia Sciuto (Dipartimento di Civiltà e Forme del Sapere – Università di Pisa)

Editorial office

Laboratorio MAPPA
Dip. Civiltà e Forme del Sapere – Università di Pisa. Via dei Mille 19, 56126 Pisa, Italy
www.mappalab.eu
<https://www.mappalab.eu/en/archeologica-data/>
e-mail: archeologicadata@mappalab.eu

Linked repository

MOD - MAPPA Open Data archive
<https://digitallib.unipi.it/it/archivio/MOD-Mappa-Open-Data-archive/>

Cover design: Sandro Petri (PetriBros Grafica)

Graphic design: All'Insegna del Giglio

Cover picture: Montelupo Fiorentino, masonry structures (photo by C. Cortina)



Archeo**Logica** *Data*

.....
N° 5.2 – 2025
.....



All'Insegna del Giglio

ISSN 2785-0307
e-ISSN 2785-0668
ISBN 978-88-9285-386-7
e-ISBN 978-88-9285-387-4



OPEN ACCESS (CC BY-NC-ND 4.0)
Attribuzione - Non commerciale
Non opere derivate 4.0 Internazionale

© 2025 All'Insegna del Giglio s.a.s.
Via Arrigo Boito, 50-52
50019 Sesto Fiorentino (FI)
www.insegnadelgiglio.it
Printed in Sesto Fiorentino (FI)
settembre 2025, BDprint

CONTENTS

Datasets published on MOD (Mappa Open Data archive)	7
Editoriale	9
Editorial.	11

Camilla Cortina

L'area dell'ex Ospedale San Luca a Lucca: revisione stratigrafica sulla base del dato ceramico	13
DOI 10.13131/UNIP1/10.13131/UNIP1/HHHR-QB18	

Ben Jervis, Kate Autumn Evetts, Benjamin Morton

Decline and Regeneration in Medieval English Townscapes	29
DOI 10.13131/UNIP1/10.13131/UNIP1/D7HQ-YN22	

Simone Sani, Niccolò Mazzucco, Davide Mengoli, Elisabetta Starnini

The obsidian management in the central Mediterranean: a case study from Fornace Cappuccini (Northern Italy, Early Neolithic).	51
DOI 10.13131/UNIP1/10.13131/UNIP1/4VQT-8Y76	

Fabio Squarcini Berti, Lorena Bravi

Dai <i>legacy data</i> alla digitalizzazione e analisi. Un database per lo studio della distribuzione dei rinvenimenti di epoca etrusca nell'area del medio valdarno . . .	71
DOI 10.13131/UNIP1/10.13131/UNIP1/RH4M-HW46	

Alexandra Teodor

Morphological Analysis Data Model for Roman Settlements	91
DOI 10.13131/UNIP1/10.13131/UNIP1/ZK1C-EW19	

Salvatore Vitale

Fifteen Years in the Cloud and 3500 Years in One Click: A Contextual Summary of Koan Prehistoric and Protohistoric Occupational Sequences . . .	109
DOI 10.13131/UNIP1/10.13131/UNIP1/XJTZ-N328	

DATASETS PUBLISHED ON MOD (MAPPA OPEN DATA ARCHIVE)

[HTTPS://DIGITALLIB.UNIPI.IT/IT/ARCHIVIO/MOD-MAPPA-OPEN-DATA-ARCHIVE/](https://digitallib.unipi.it/it/archivio/mod-mappa-open-data-archive/)

Camilla Cortina

L'area dell'ex Ospedale San Luca a Lucca: revisione stratigrafica sulla base del dato ceramico

LINK AL DATASET: 10.13131/UNIFI/VFG7-RN69

Ben Jervis, Kate Autumn Evetts, Benjamin Morton

Decline and Regeneration in Medieval English Townscapes

LINK AL DATASET: 10.13131/UNIFI/27NV-FY64

Simone Sani, Niccolò Mazzucco, Davide Mengoli, Elisabetta Starnini

The obsidian management in the central Mediterranean: a case study from Fornace Cappuccini (Northern Italy, Early Neolithic)

LINK AL DATASET: 10.13131/UNIFI/2DIN-DT52

Fabio Squarcini Berti, Lorena Bravi

Dai *legacy data* alla digitalizzazione e analisi. Un database per lo studio della distribuzione dei rinvenimenti di epoca etrusca nell'area del medio valdarno

LINK AL DATASET: 10.13131/UNIFI/YEGR-RM48

Alexandra Teodor

Morphological Analysis Data Model for Roman Settlements

LINK AL DATASET: 10.13131/UNIFI/9B48-6R69

Salvatore Vitale

Fifteen Years in the Cloud and 3500 Years in One Click: A Contextual Summary of Koan Prehistoric and Protohistoric Occupational Sequences

LINK AL DATASET: 10.13131/UNIFI/RTMZ-NG73

EDITORIALE

Questo nuovo numero di Archeologica Data accoglie una serie di contributi che spaziano da studi stratigrafici e analisi ceramiche fino alla gestione delle risorse esogene nel Mediterraneo antico, offrendo nuove prospettive su contesti storici e archeologici diversificati. Ancora una volta, la forza distintiva della rivista risiede nella condivisione dei dati della ricerca: tutti i contributi pubblicati sono accompagnati da dataset open data, liberamente scaricabili dal repository MOD.

Camilla Cortina propone una revisione stratigrafica dell'area dell'ex Ospedale San Luca a Lucca, basata sui dati ceramici. Il suo studio non solo arricchisce la conoscenza dell'area, ma solleva anche interrogativi sull'attribuzione delle strutture individuate alla corte marchionale, suggerendo l'importanza di una lettura critica delle evidenze archeologiche.

Ben Jervis, Kate Autumn Evetts e Benjamin Morton riprendono da una prospettiva archeologica il dibattito storiografico sul declino della città nell'Inghilterra del tardo medioevo. A partire dall'analisi dei dati di scavo e degli edifici storici gli autori evidenziano l'insostenibilità di una narrazione univoca di decadenza urbana, proponendo un'interpretazione legata alle specifiche vicende locali e basata sul processo di rigenerazione sia degli spazi che della società urbana.

Simone Sani, Niccolò Mazzucco, Davide Mengoli ed Elisabetta Starnini esplorano la gestione dell'ossidiana nel Mediterraneo centrale durante il Neolitico, utilizzando come caso studio il sito di Fornace Cappuccini. L'indagine evidenzia come la materia prima esogena fosse utilizzata in modo differenziato rispetto alle industrie locali in selce, rivelando le complesse reti di scambio e specializzazione dei primi agricoltori.

Fabio Squarcini Berti e Lorena Bravi presentano un approccio innovativo per l'analisi dei *legacy data* relativi ai rinvenimenti di epoca etrusca nell'area del Medio Valdarno, utilizzando strumenti di analisi spaziale come QGIS e R. Questo contributo dimostra come l'uso di dati spesso trascurati, possa offrire nuovi spunti interpretativi sulla distribuzione dei ritrovamenti archeologici.

Alexandra Teodor propone un sistema di schedatura e analisi per gli insediamenti urbani romani, sviluppato a partire dal caso studio delle città della provincia romana di Scizia (Dobrudja). Il suo contributo delinea una metodologia standardizzata per la documentazione delle caratteristiche urbane aprendo la strada a una maggiore sistematicità nello studio dell'urbanistica antica.

Infine, Salvatore Vitale presenta una sintesi contestuale delle sequenze occupazionali preistoriche e protostoriche dell'isola di Kos, risultato del "Serraglio, Eleona and Langada Archaeological Project" (SELAP). Integrando dati di scavo storici e recenti,

questo studio dimostra ancora come i *legacy data*, se criticamente interpretati, possano offrire contributi significativi alla conoscenza archeologica.

Questi contributi eterogenei dimostrano come la rilettura critica dei *legacy data* possa offrire nuove prospettive e approfondimenti e sottolineano l'importanza fondamentale di condividere i dati grezzi della ricerca. La disponibilità di dataset open data nel repository MOD garantisce trasparenza, verificabilità e un dialogo continuo nella comunità scientifica, promuovendo una ricerca archeologica solida e collaborativa.

EDITORIAL

This new issue of *Archeologica Data* features a series of contributions ranging from stratigraphic studies and ceramic analyses to the management of exogenous resources in the ancient Mediterranean, offering new perspectives on diverse historical and archaeological contexts. Once again, the journal's distinctive strength lies in the sharing of research data: all published contributions are accompanied by open data datasets, freely downloadable from the MOD repository.

Camilla Cortina presents a stratigraphic review of the area of the former San Luca Hospital in Lucca, based on ceramic data. Her study not only enriches the understanding of the area but also raises questions about the attribution of the identified structures to the marquisal court, highlighting the importance of critically interpreting archaeological evidence.

Ben Jervis, Kate Autumn Evetts, and Benjamin Morton revisit the historiographical debate on the decline of cities in late medieval England from an archaeological perspective. Starting from an analysis of excavation data and historical buildings, the authors highlight the unsustainability of a single narrative of urban decline, proposing an interpretation linked to specific local events and based on the process of regeneration of both urban spaces and society.

Simone Sani, Niccolò Mazzucco, Davide Mengoli, and Elisabetta Starnini explore the management of obsidian in the central Mediterranean during the Neolithic, using the site of Fornace Cappuccini as a case study. The investigation reveals how this exogenous raw material was used differently from local flint industries, uncovering the complex networks of exchange and specialization among early farmers.

Fabio Squarcini Berti and Lorena Bravi present an innovative approach to the analysis of legacy data related to Etruscan finds in the Middle Valdarno area, using spatial analysis tools such as QGIS and R. This contribution demonstrates how the use of often overlooked data can provide new interpretative insights into the distribution of archaeological finds.

Alexandra Teodor proposes a data collecting and analysis system for Roman urban settlements, developed from the case study of towns in the Roman province of Scythia (Dobrudja). Her contribution outlines a standardized methodology for documenting urban features, paving the way for greater systematicity in the study of ancient urbanism.

Finally, Salvatore Vitale presents a contextual synthesis of the prehistoric and protohistoric occupational sequences of the island of Kos, resulting from the “Serraglio, Eleona, and Langada Archaeological Project” (SELAP). By integrating historical

and recent excavation data, this study further demonstrates how legacy data, when critically interpreted, can offer significant contributions to archaeological knowledge.

These diverse contributions demonstrate how a critical reinterpretation of legacy data can offer new perspectives and insights, while also emphasizing the fundamental importance of sharing raw research data. The availability of open data datasets in the MOD repository ensures transparency, verifiability, and continuous dialogue within the scientific community, promoting robust and collaborative archaeological research.

Camilla Cortina*

* Università di Pisa, Dip. Civiltà e Forme del Sapere (camilla.cortina@phd.unipi.it).

L'AREA DELL'EX OSPEDALE SAN LUCA A LUCCA: REVISIONE STRATIGRAFICA SULLA BASE DEL DATO CERAMICO

Abstract: Between 2005 and 2006, in-depth excavations were carried out on a building from the former San Luca Hospital, located between Via San Paolino and Via del Crocifisso in Lucca. These investigations uncovered numerous ceramic fragments and a series of structures, one of which was identified by Giulio Ciampoltrini as a possible part of the *corte marchionale* (marquisal court) documented as early as 974. The study of the ceramic findings

enabled a complete revision of the stratigraphic sequence and deepened the understanding of the area. However, it is not possible to state with certainty that the wall in question belonged to the center of marquisal power, as specific archaeological indicators for dating and interpreting the structure are lacking.

Keywords: Lucca, corte marchionale, Ospedale San Luca, ceramica.

1. Introduzione

Tra il 2005 e il 2006, la Soprintendenza Archeologica della Toscana ha effettuato undici saggi stratigrafici di varie dimensioni e profondità durante i lavori di ristrutturazione dell'albergo San Luca, situato in via San Paolino a Lucca. Quest'area è considerata di rilevante interesse storico poiché la struttura si erge sul sito dell'antico ospedale della Misericordia o di San Luca. Secondo Giulio Ciampoltrini, in questa zona si sono susseguiti diversi luoghi del potere cittadino medievale, tra cui il "palazzo pubblico" bizantino, la *curtis ducalis* e il palazzo del Marchese della Tuscia (Ciampoltrini 2011, p. 54).

Grazie alla collaborazione con la Soprintendenza Archeologia, Belle Arti e Paesaggio per le province di Lucca e Massa Carrara, e in particolare alla dottoressa Neva Chiarenza, ho potuto intraprendere uno studio approfondito della documentazione di scavo. Questo ha permesso di analizzare i materiali ceramici rinvenuti, con l'obiettivo di ricostruire la sequenza stratigrafica del sito e individuare le tracce delle strutture di potere medievali e dell'Ospedale.

2. L'area dell'ex ospedale San Luca

Gli scritti di Isa Belli Barsali rappresentano una fonte imprescindibile per la ricostruzione della topografia medievale e moderna della città di Lucca (Belli Barsali 1973 e 1988). Attraverso lo studio della documentazione manoscritta conservata nell'archivio di Lucca, la studiosa individua l'Ospedale della Misericordia, noto anche come di San Luca per la presenza della chiesa annessa (distrutta agli inizi del XX secolo), nell'angolo di via San Paolino (fig. 1). Fondato dalla Corte dei Mercanti nel 1262 e ampliato nel corso del XIV secolo, questo ospedale fu il principale di Lucca nel Cinquecento, arrivando a gestire circa quaranta tra chiese, ospedali e monasteri distribuiti sul territorio. Tra i meglio documentati: Palazzo Sirti, poi Mansi, viene annesso nel 1458, destinato al ricovero degli orfanelli; la sede della Compagnia della Croce, che aveva il compito di assistere i condannati a morte e ricevere i pellegrini, viene unita ai beni di S. Luca nel 1801; l'Ospedale degli Incurabili (malati di malattie veneree) venne annesso nel 1799 (Belli Barsali 1988, p. 122).

Il complesso ospedaliero era suddiviso in due sezioni: la sezione maschile, collocata tra via del Crocifisso e le mura medievali, e la sezione femminile e pediatrica, situata a sud-est del monastero di Santa Giustina (oggi sede dell'Anagrafe Comunale). L'area di scavo del 2005-2006 si trova proprio nella struttura principale dell'ospedale e ha interessato sei ambienti seminterrati, interrati in epoca contemporanea.

Giulio Ciampoltrini identifica quest'area come la sede della *curtis ducalis*, successivamente divenuta il palazzo del Marchese della Toscana. Egli interpreta una muratura in ciottoli, in parte sbazzati e disposti su filari tendenzialmente regolari, legati da malta grigiastra, come la fondazione di una struttura del VI secolo, rimaneggiata più volte fino all'XI secolo, e parte integrante di questo centro di potere (Ciampoltrini 2011, p. 54).

Isa Belli Barsali analizza in dettaglio i principali centri di potere all'interno del tessuto urbano di Lucca. Attraverso lo studio delle fonti scritte, identifica la *curtis regia* longobarda, comprendente la zecca e la *curtis reginae* con le loro strutture annesse, nella zona compresa tra piazza San Giusto e piazza XX Settembre, ipotesi poi confermata dai saggi di scavo eseguiti nel 2009 (Cantini et alii, 2021). La studiosa osserva inoltre che nel 974 il palazzo marchionale fu trasferito "fuori la porta di San Donato", e dotato di una grande sala, una loggia, una cappella palatina (Santo Stefano) e la chiesa di San Benedetto in *Palatio*.

Successivamente, nel 1197, la sede del potere venne spostata nuovamente presso il *palatium civitatis*, vicino alla chiesa di San Michele in Foro, che divenne la residenza dei consoli o del Podestà. Il 7 giugno 1322, su iniziativa di Castruccio Castracani, iniziò la costruzione dell'Augusta, un imponente edificio attribuito, secondo la tradizione, al progetto di Giotto. Tuttavia, già alla fine del secolo, il consiglio degli Anziani ne decretò la demolizione, e al suo posto fu eretto l'attuale Palazzo Provinciale (Belli Barsali 1988, p. 20).

Le fonti scritte, e in particolare dalle date topiche delle notizie di placito, indicano che la corte marchionale si trovava appena fuori dalle mura occidentali di Lucca (*quod est prope muros de civitatem Luca*, 1055). La cappella palaziale era la chiesa di San Benedetto in *Palatio* (oggi conosciuta come chiesa del Crocifisso dei Bianchi),

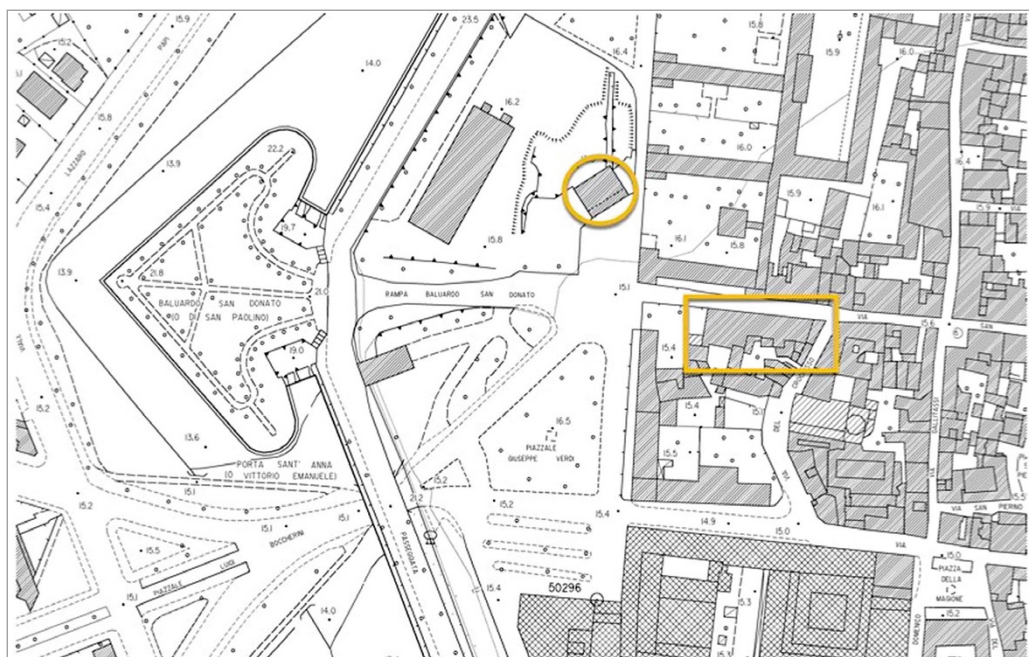


fig. 1. Ubicazione dell'area indagata presso l'ex ospedale San Luca.

e vi si trovava anche una cappella dedicata a Santo Stefano, ancora menzionata nel Cinquecento.

Il complesso palaziale si estendeva probabilmente su un'ampia superficie, come avveniva a Pavia, comprendendo vasti loggiati (*laubia maiore*, 964; *laubia longanea solarii*, 941; *porticho ipsius sale*, 973) che si aprivano su un cortile centrale. La struttura includeva inoltre uno o più edifici di rappresentanza, con almeno uno sviluppato su due piani, come testimoniano riferimenti alla *sala terrestre* (853), alla *caminata* (869 e 873), al *solario* con cappella dedicata a Santo Stefano (941) e alla *casa quod est sala de palatio* (1058).

Tenendo in considerazione il rapporto tra il *pratum* e il *cursus* del marchese, le mura, la chiesa del Crocifisso dei Bianchi e quella di Santo Stefano, l'ubicazione più probabile del complesso, supportata dagli studi di Isa Belli Barsali e Romano Silva (Seidel, Silva 2007) sembra essere nell'area compresa tra via del Crocifisso (caratterizzata da un suggestivo andamento curvilineo), via San Paolino e via Vittorio Emanuele II¹.

3. Lo scavo

L'area dell'intervento si situa all'interno del piano terra e del piano seminterrato del palazzo, già parte dell'ospedale San Luca di Lucca, posto lungo il lato meridionale di via San Paolino e confinante a ovest con l'area dell'ex chiesa di San Luca. La

¹ Si ringrazia per le informazioni specifiche riguardo le fonti scritte il Dott. Paolo Tomei.

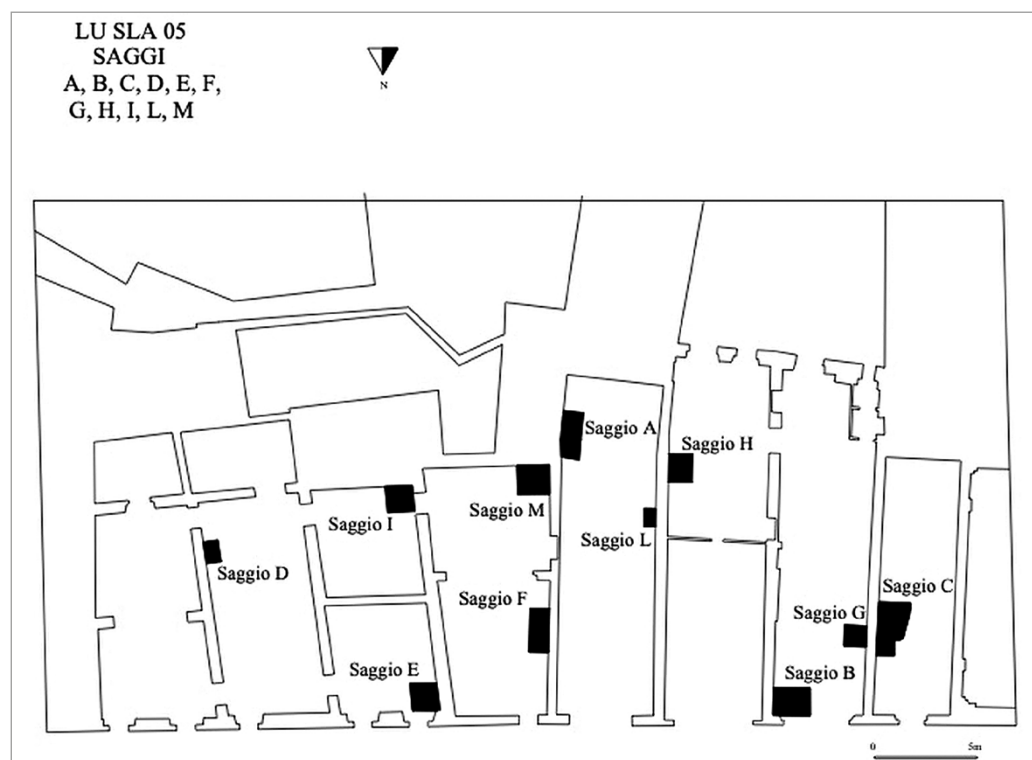


fig. 2. Planimetria totale dell'area di scavo (a cura di A. Fornaciari).

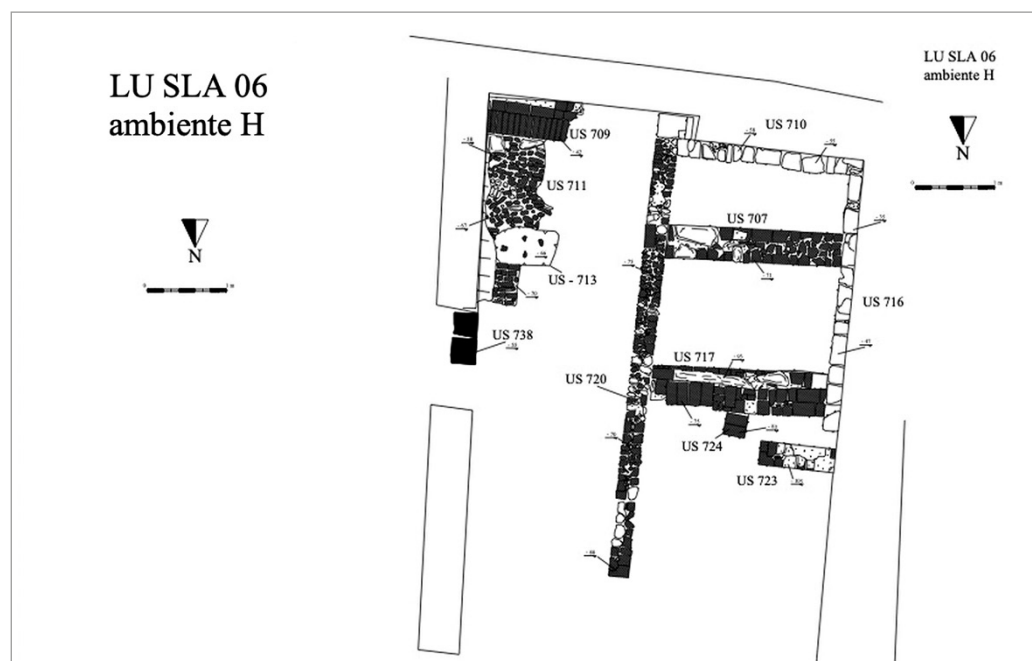


fig. 3. Pianta generale dell'ambiente H – area 700 (a cura di A. Fornaciari).

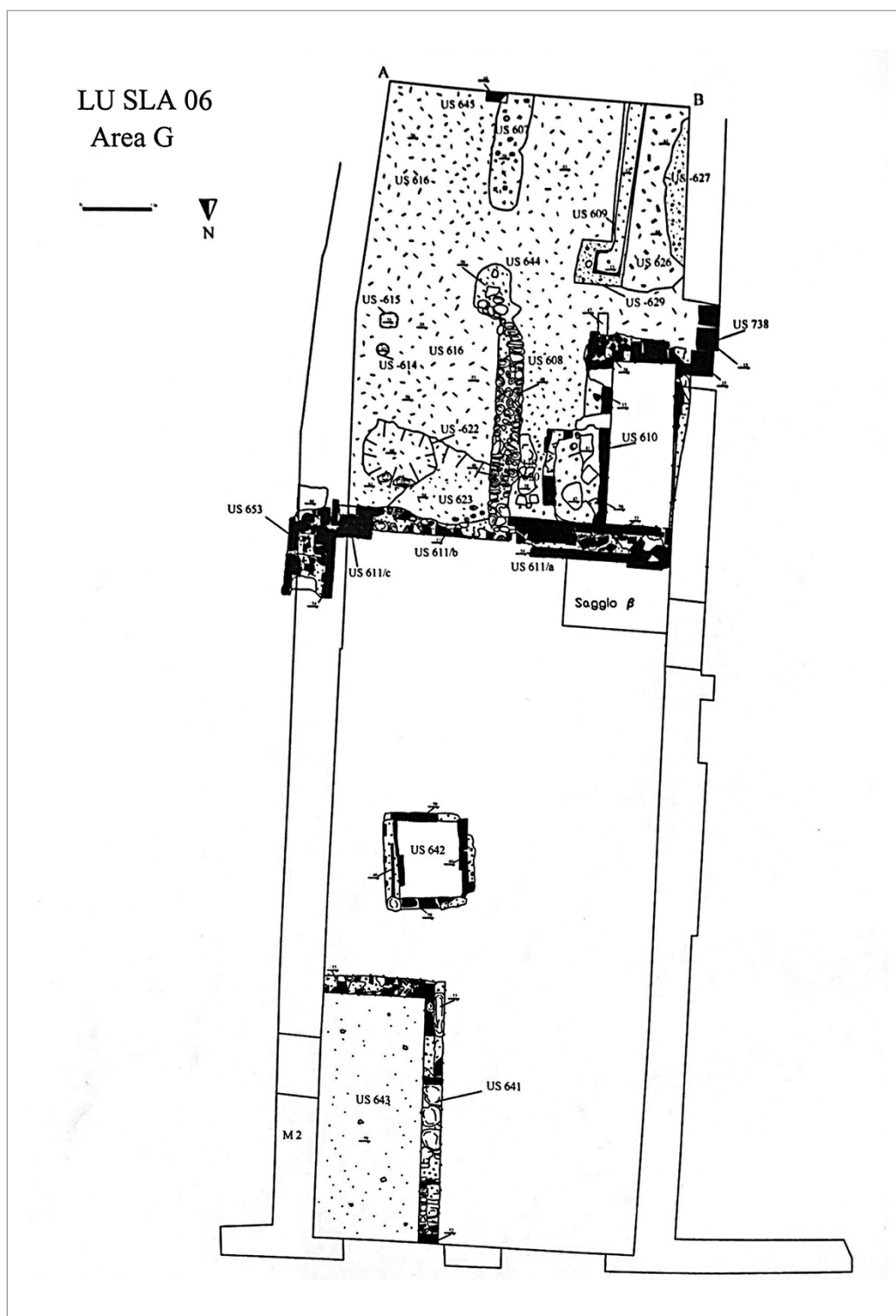


fig. 4. Pianta generale dell'area G – area 600 (a cura di A. Fornaciari).



fig. 5. Frammento di ceramica ingobbiata e graffita a punta sotto vetrina policroma, con rappresentazione di uno pseudostemma, tipologia di decoro molto diffusa a partire dal XVI secolo d.C. nei contesti urbani lucchesi.

ristrutturazione del fabbricato, dopo i saggi praticati nell'autunno 2005, ha comportato l'isolamento dei pavimenti tramite la creazione di vespai in materiale plastico e la necessità di operare uno scavo per una profondità di 70 cm all'interno dei vani del corpo occidentale; per quanto riguarda il corpo orientale del palazzo il progetto di ristrutturazione ha previsto il recupero anche dei vani seminterrati, colmati nel corso dell'età moderna e contemporanea da una mole notevole di scarichi e rifiuti (fig. 2). L'intervento ha interessato sei ambienti posti al pianoterra del fabbricato. Lo scavo è stato effettuato, per quanto riguarda i livelli superficiali, con l'ausilio di un mezzo meccanico ed è proseguito manualmente con la collaborazione di due operatori non specializzati, sotto la guida di Antonio Fornaciari e la supervisione della Dott.ssa Elisabetta Abela; la direzione scientifica è del Dott. Giulio Ciampoltrini. L'esecuzione e la stesura della documentazione sono state curate dal dott. Antonio Fornaciari.

Sono state qui analizzate due aree di scavo, identificate come Area 700 – Saggio H (fig. 3) e Area 600 – Saggio G (fig. 4), selezionate per la loro ampiezza e per l'elevato numero di frammenti ceramici rinvenuti (n. tot. 1974; 25 classi. fig. 5), che hanno consentito una ricostruzione dettagliata della sequenza stratigrafica (fig. 6; fig. 7). Lo studio delle classi ceramiche, databili dal medioevo fino all'età contemporanea, ha permesso di eseguire una revisione completa della sequenza stratigrafica, delle datazioni e delle interpretazioni formulate durante le fasi di scavo.

Area 700

Periodo 4: ante XIII secolo d.C.

Nella porzione sud occidentale dell'ambiente sono stati localizzati i residui di due imponenti strutture murarie (**Fase 7**), orientate rispettivamente est-ovest (**USM 710**) e nord-sud (**USM 716**, fig. 8), lunghe 2,38 m e 3,25 m, che ammorzano ad angolo retto. Della prima si conservano le fondazioni ed una piccola parte dell'elevato, pari ad appena 30 cm, mentre della seconda, oltre alla struttura delle fondamenta, è possibile

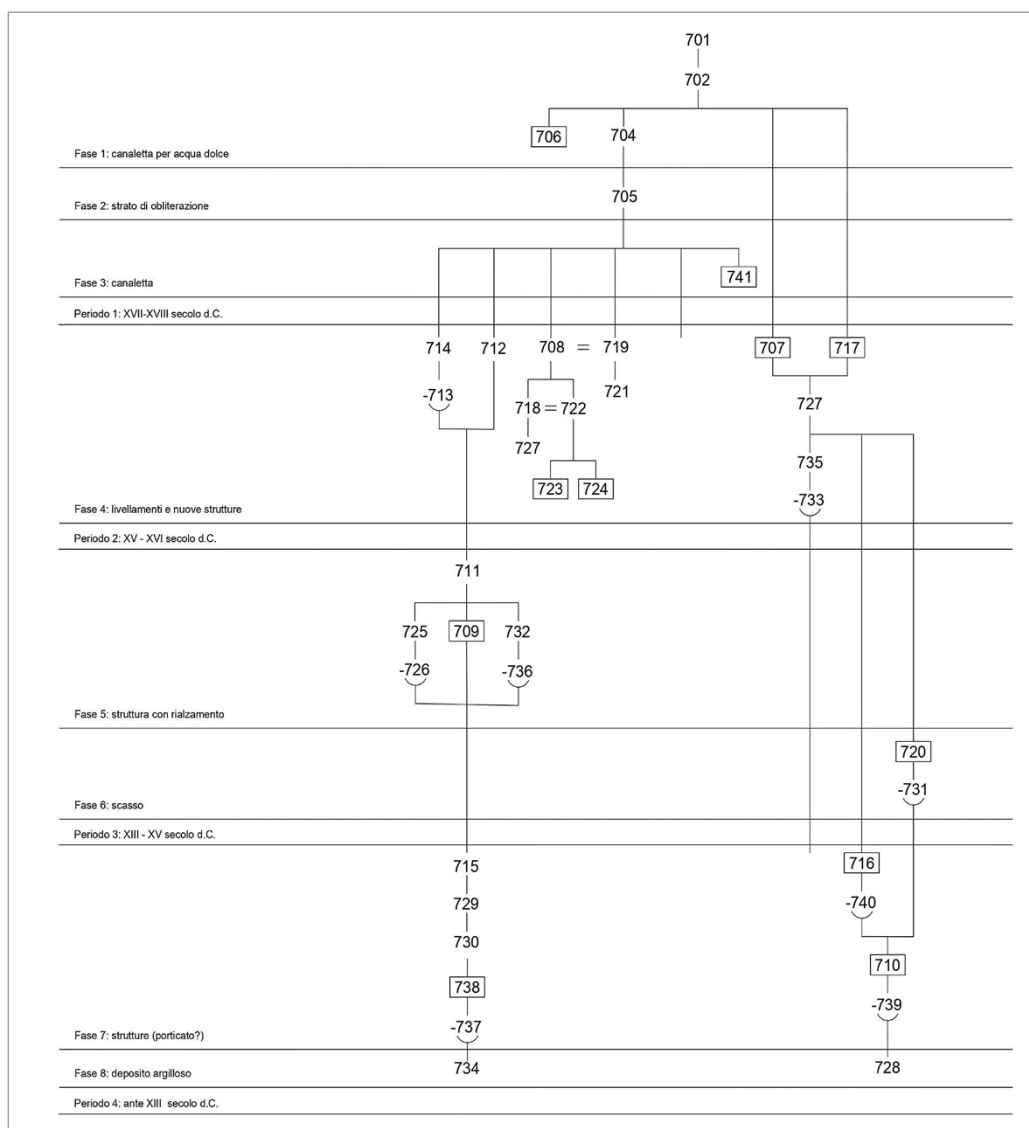


fig. 6. Rappresentazione del diagramma stratigrafico dell'Area 700.

leggere una porzione consistente dell'elevato per uno sviluppo verticale di 1,80 m ed una larghezza di 1,50 m circa, interpretati come possibili strutture riferibili a un porticato. La porzione inferiore delle fondazioni di entrambe le strutture è costituita da una gettata di ciottoli selezionati di piccole dimensioni (2-4 cm di diametro) mescolati a sedimento argillo-sabbioso, a cui si sovrappongono ciottoli di dimensioni maggiori con diametro di 7-10 cm, realizzata riempiendo fosse di fondazione (**UUSS -739 e -740**) che tagliano un deposito limo argilloso (**US 728 – Fase 8**) il quale, a causa dell'affioramento dell'acqua di falda, è stato indagato con tagli artificiali progressivi di 10 cm (**US 728/1-2-3**) fino alla profondità di -1,90 m circa, ed ha restituito materiali ceramici d'età tardoantica (vasi a listello, sigillate africane) ed altomedievale (piede

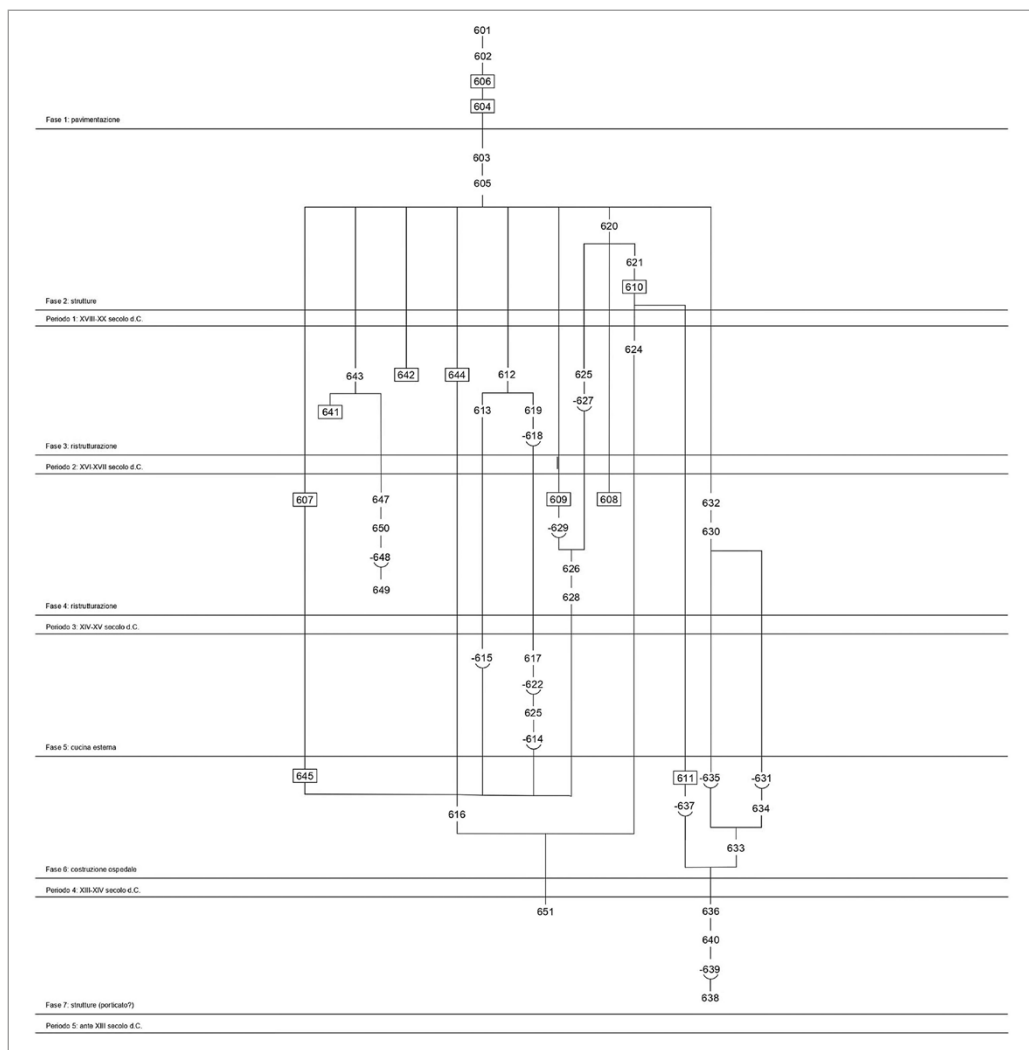


fig. 7. Rappresentazione del diagramma stratigrafico dell'Area 600.

invetriato di una lampada, catino depurato). Questi materiali non sono presenti tra quelli studiati, ma sono citati nella relazione di scavo.

La porzione superiore della fondazione di **USM 710** presenta una serie di cinque corsi composti da ciottoli disposti verticalmente o leggermente inclinati, diversi dei quali spaccati, uniti ad alcuni elementi litici di calcare di forma quadrangolare e rettangolare spianati a mazzetta, di dimensioni variabili, ma alti mediamente intorno ai 15 cm. Per favorire l'allettamento degli elementi litici il piano di posa è stato regolarizzato con l'inserimento di alcuni ciottoli sottili posti di piatto. L'ultimo filare delle fondamenta, che forma una risega larga 20 cm, costituito interamente da elementi litici sub rettangolari e quadrangolari, si interrompe un metro e mezzo ad est dell'ammoratura con **USM 716**, dove si ha, quella che viene definita in corso di scavo, una cesura verticale nell'apparecchiatura che definisce probabilmente una giustapposizione



fig. 8. UUSSMM 710 e 716.

nella realizzazione della muratura, indizio che la costruzione di questa porzione delle fondazioni è avvenuta in due tempi. L'elevato di **USM 710** è conservato per appena uno/due filari di elementi litici di larghezza variabile ed alti mediamente circa 15 cm.

In corrispondenza dello spigolo orientale si nota l'inserimento sul cantonale di una pietra squadrata, forse ricavata da una bozzetta rilavorata, con spianatura a punta singola e rifilatura a nastro. Il legante è costituito da un sedimento argillo-sabbioso poco tenace. La struttura **USM 716** si diversifica dalla precedente a livello delle fondazioni, infatti, al di sopra della porzione realizzata in gettata, si hanno due filari molto irregolari di ciottoli, per lo più non spaccati, alternati ad alcuni elementi litici in calcare, sormontati da cinque corsi piuttosto regolari di pietre sommariamente squadrate e spianate a mazzetta, con un impiego assai parco di ciottoli, che vanno progressivamente assottigliandosi verso la risega, passando da 20 a 6 cm di spessore. In corrispondenza della parte centro settentrionale della fondazione si nota la presenza di un'incrostazione calcarea, larga circa 1 m, che, generata da un flusso continuo di umidità, ha inizio a livello della risega e raggiunge la parte inferiore delle fondamenta. La porzione di elevato, conservata per un'altezza di circa 1,80 m ed una larghezza di 1,5 m, si sviluppa in tredici filari meno regolari rispetto alle fondazioni. Nella porzione superiore, ed in particolare negli ultimi tre filari, si fa più frequente l'inserimento, accanto agli elementi litici sommariamente squadrate, di ciottoli spaccati. Ad una fase posteriore vanno ricondotti sia l'inserimento di laterizi che la presenza di residui di

malta negli interstizi tra le pietre ed i ciottoli. Il legante utilizzato, osservabile a livello delle fondazioni, è una miscela argillo-sabbiosa non troppo tenace.

Lungo il perimetrale orientale del vano e coperta in parte da questo, a 2,35 m dall'angolo sud est dell'area, è stata documentata una struttura (**USM 738, Fase 7**) quadrangolare di 1×1 m formata da ciottoli, frammenti di laterizi e abbondante malta grigia, sormontata da una copertura in elementi litici quadrangolari spessi 20 cm, che doveva costituire la base di un pilastro. La superficie in pietre squadrate si colloca a -55 cm, mentre la fondazione, realizzata contro terra, è documentata fino alla profondità di -1,40 m, e la sua fossa (**US -737**) taglia uno strato argillo-limoso (**US 734, Fase 8**) di colore marrone scuro contenente frammenti di pietra e di laterizi che restituisce materiali medievali. È possibile che la struttura 738 formasse una componente, insieme all'**US 645** (base di pilastro messa in luce nell'area contigua), di un sistema porticato collegato alle murature **UOSSMM 710 e 716**. Un approfondimento stratigrafico a lato della struttura USM 738 ha mostrato la presenza, sopra US 734, alla quota di -84, di un piano di malta (**US 729**) spesso 3 cm, soprastante uno strato di preparazione (**US 730**) a base di limo, sabbia e pietrisco, che purtroppo, a causa di una buca (**US -736**) realizzata intorno alla fine del XV secolo, è interrotto in corrispondenza del perimetrale orientale dell'area. Questo piano US 729 potrebbe costituire un livello di cantiere da porre in relazione con la costruzione della struttura US 738.

Periodo 3: XIV secolo d.C.

L'edificazione della fabbrica dell'ospedale basso medievale apporta notevoli modificazioni. Le murature messe in evidenza nel periodo 4 vengono inglobate nella nuova struttura. Sopra al piano di malta **US 729** viene deposto uno strato di rialzamento (**US 715, Fase 5**), spesso una dozzina di centimetri, a matrice argillo-limosa, su cui vanno ad impostarsi una soglia in laterizi (**USM 709**), connessa con un ingresso nel perimetrale sud, ed una pavimentazione (**US 711**) di laterizi posti di taglio di cui resta una porzione nell'angolo sud orientale dell'area. Nella parte sud occidentale dell'ambiente, lungo il perimetrale ovest, viene operato un grosso scasso rettangolare (**US -731, Fase 6**), che giunge fino a quota -1,45 m, delimitato a est da un muretto di contenimento (**USM 720**) con orientamento nord sud, largo appena 28 cm e lungo 5,70 m, composto di frammenti di laterizi, tra cui anche pezzi di embrici, e ciottoli legati con terra argillosa.

Periodo 2: seconda metà XVI secolo d.C.

Nella seconda metà del XVI secolo viene praticato un taglio sub rettangolare (**US -713**) nella pavimentazione US 711, profondo 15-18 cm, riempito da un sedimento sabbio limoso marrone scuro (**US 714**) contenente ceramica. Sopra la pavimentazione US 711 si accumula uno strato limo sabbioso (**US 712**) che restituisce ceramica. Lo spazio compreso tra US 720 ed il perimetrale occidentale diventa oggetto di alcuni interventi che ne modificano l'organizzazione: vengono edificate due strutture murarie (**UOSSMM 707 e 717, Fase 4**), databili, sulla base dei materiali ceramici rinvenuti nelle fondazioni e nello strato sul quale si impostano (**US 727**), alla seconda metà del '500. Si tratta di due setti murari, conservati per un'altezza di 55 cm, con orientamento est-ovest, realizzati in laterizi di varie dimensioni ed, a livello delle fondazioni, alte

una quarantina di centimetri, che impiegano elementi litici di pietra di Guamo. Il legante è costituito da una malta grigia, non molto tenace, e tendenzialmente sabbiosa, distesa in letti sottili.

La struttura **USM 707** ha una larghezza di 40 cm, mentre l'**USM 717** ha una larghezza di 50 cm a livello delle fondazioni ed un elevato parzialmente collassato verso nord, conservato per appena 18-20 cm di altezza.

Sempre materiali cinquecenteschi sono restituiti dagli strati (**UUSS 718, 721, 722**) che riempiono gli spazi definiti dalle fondazioni delle strutture **UUSSMM 707** e **717**, contestuali alla costruzione delle murature stesse, a partire dalla quota di -1,25 m. Al paramento nord di **USM 717** si appoggiano i resti di una struttura (**USM 724**) quadrangolare formata da due laterizi posti di piatto, probabile basamento di un pilastro, mentre ad una distanza di circa 20 cm si trovano i residui di un'altra struttura muraria in laterizi (**UUSSMM 723**), che si sviluppa parallelamente a **USM 717**.

Periodo 1: XVII-XVIII secolo d.C.

Nella porzione nord orientale dell'area viene costruita una grossa cisterna (**USM 741**) destinata alla raccolta delle acque chiare. Tutta realizzata in laterizi, è costituita da un ambiente di 2,70x2,40 m voltato a botte, la cui altezza al colmo misura 1,80 m, mentre all'imposta della volta è di soli 87 cm, rinforzato da quattro spallette ai bordi ed intorno all'originaria apertura quadrangolare, già murata in antico. I laterizi della volta misurano 30x4,2x15 cm, mentre quelli dei perimetrali misurano 31x5 cm. L'interno è pavimentato in quadrucci laterizi di 29x33 cm e presenta una marcata pendenza verso nord-est, dove, dalla volta, trova sbocco un condotto a sezione quadrangolare munito nella parte terminale di due embrici sovrapposti con funzione di scivolo. Sul perimetrale nord, immediatamente sotto la volta, si trova l'ingresso di un altro piccolo condotto, che doveva svolgere la funzione di "troppo pieno" smaltendo l'acqua in esubero in direzione nord; è molto probabile che l'**US 703**, individuata nel saggio B dell'Autunno 2005, inglobasse proprio questa condotta proveniente dalla struttura **USM 741**. Uno strato macerioso (**US 705**), con frammenti di laterizi e malta, contenente materiale ceramico del XVI-XVII e XVIII secolo obliterava le strutture messe in luce nell'area. All'interno degli spazi delimitati dalle strutture **UUSSMM 707** e **717** sono stati individuati due primi strati di riempimento (**UUSS 708 e 719**) del tutto simili a **705**, che hanno restituito materiali del XVIII secolo.

Area 600

Periodo 5: ante XIII secolo d.C.

Le più antiche evidenze archeologiche comprendono una struttura quadrangolare (**US 645, fase 7**), situata a metà circa del perimetrale meridionale del vano, forse interpretabile come un porticato. È realizzata in ciottoli d'arenaria e pezzi di pietra legati da abbondante malta per l'inserimento di alcuni frammenti laterizi per uno spessore apprezzabile di 31 cm. La sua fossa di fondazione taglia uno strato argilla limoso di colore marrone giallastro (**US 651**) che restituisce frustoli laterizi e ha uno sviluppo verticale di oltre 60 cm a partire da una cresta di rasatura situata a quota -44 cm. Si tratta probabilmente della base di un pilastro, che va connessa, per tecnica costruttiva

e quote di rinvenimento, con le più antiche murature dell'area H. Il pilastro è stato inglobato in età basso medievale (XIII secolo) nelle fondazioni del perimetrale meridionale della fabbrica dell'ospedale. Nella porzione dell'area immediatamente a nord del setto murario us 611, dove è stato eseguito un approfondimento stratigrafico di piccole dimensioni (saggio alfa), è stato individuato alla quota di -1,02 m un battuto argilloso (**US 638**) caratterizzato da piccoli frammenti di laterizi e di calcare giallastro, tagliato da una buca di palo sub circolare (**US -639**, riempimento **US 640**) del diametro di 25 cm caratterizzato da un'appendice sub circolare di 15 cm. Il livello di vita del battuto è coperto da uno strato (**US 636**) di colore nero, limoso, spesso circa 18 cm, contenente piccoli carboni e inglobante sottili lenti limose giallastre, che restituisce frammenti residui di anforacei. Si tratta di livelli d'occupazione d'età altomedievale, connessi con strutture in materiale deperibile, che si collocano cronologicamente prima dell'edificazione delle murature in laterizi legate alla fabbrica dell'ospedale di San Luca.

Periodo 4: XIII-XIV secolo d.C.

L'erezione della struttura muraria **US 611 (fase 6)** segna un generale ristrutturazione dell'area, d'ora in poi connessa con la fabbrica dell'ospedale San Luca (seconda metà XIII secolo). La struttura muraria us 611, larga 54 cm, attraversa in senso est-ovest la porzione centrale del vano e ha un cresta di rasatura costituita da laterizi posti prevalentemente di fascia, dalle dimensioni non omogenee, che misurano 30-33×12-14×5 cm, ed a cui si aggiungono alcuni laterizi impiegati nella muratura. Il paramento del lato meridionale di 611 è leggibile per una dozzina di filari nel tratto a cui si è appoggiata la struttura 610 e vi si nota l'utilizzo, sopra una fondazione in malta e ciottoli situata a quota -110, di laterizi di dimensioni diverse, spessi da un massimo di 5,5 comunque a un minimo di 4 cm, e posti in opera sia di testa che di fascia a formare corsi tra di loro regolari e omogenei. Nel saggio rettangolare di 1×1,5 m (saggio beta), praticato immediatamente a nord di us 611 per verificare profondità e tipologia delle fondamenta della struttura, sono state messe in evidenza, a quota -85 le fondazioni della stessa, costituite da una gettata di ciottoli, frammenti laterizi e malta (**US 652**) all'interno dell'ampia fossa di fondazione **US -637**, larga circa 20 cm, ben definibile a partire dall'interfaccia superiore dello strato us 636. Sopra le fondazioni sono stati messi in luce una serie di strati a matrice mista (**UUSS 633, 634**), caratterizzati da presenza abbondante di malta, identificabili come livelli di cantiere relativi alla costruzione in elevato della muratura di 611, interessati da alcune buche sub circolari del diametro di circa 30 cm (**UUSS -635, -631**) destinate probabilmente al sostegno di impalcature lignee utilizzate nella fase di edificazione, mentre non sono stati evidenziati livelli pavimentali da riferire con sicurezza alla vita della struttura us 611. La differenza di quota nella profondità delle fondazioni di us 611 a nord e sub potrebbe essere messa in relazione con una difformità nella morfologia del terreno prima dell'impianto della fabbrica ospedaliera, oppure potrebbe essere giustificata da una differenza strutturale tra un esterno, a sud, ed un interno, a nord, di cui per altro non si conservano i livelli pavimentali che dovevano collocarsi a una quota maggiore e che hanno subito, come del resto le strutture messe in evidenza a livello delle loro creste di rasatura, interventi di asportazione nel corso dell'età moderna. La struttura us 611 si congiunge verso est, appoggiandovisi, al perimetrale orientale del vano che conserva la propria veste in

laterizi basso medievali fino allo spigolo nord orientale dell'ambiente per uno sviluppo di 9,90 m, e del quale, grazie all'apertura di una breccia praticata in età contemporanea, è stato possibile leggere in pianta una piccola porzione (**US 652**). La struttura us 652, larga circa 70 cm, è costituita da laterizi diversi di 28-30×12-13×5 cm, posti di testa e di fascia, impiegati nella muratura nonostante la loro incompletezza, e costituisce un residuo della fabbrica basso medievale dell'ospedale, di cui si conservano, oltre al già citato us 611, anche un breve tratto nel perimetrale occidentale per uno sviluppo di 3 m a partire dallo spigolo nord occidentale, ed un tratto di 2,9 m nel perimetrale meridionale a partire dallo spigolo sud occidentale, inglobante la struttura us 645 (cfr f.1), il quale mostra una fondazione in ciottoli di fiume legati da abbondante malta grigia, disposti irregolarmente a spina di pesce in cinque corsi orizzontali sui quali si impostano quattro filari di mattoni, spessi tra 5,5 e 6 cm.

Nel settore a sud est di us 611 è presente uno strato limoso (**US 616**) di colore marrone verdastro contenente maiolica arcaica di prima fase.

Su questo livello 616 si svolgono una serie di attività antropiche come la realizzazione di alcune buche di palo (**UUSS -614, -615, fase 5**), forse da collegare alla predisposizione di una copertura di materiale deperibile, che connoterebbero l'area, utilizzata come cucina, come esterna rispetto all'edificio delimitato dalla struttura 611, ed inoltre si verifica l'accumulo di alcuni piccoli depositi sabbio-limosi (**US 623**), ma soprattutto si impianta un piccolo focolare realizzato all'interno di una fossa circolare ampia 1 metro, poco profonda (**US -622**), contenente lastre di scisto disposte di piatto a creare un piano di cottura, riempita da uno strato limo-sabbioso (**US 617**) arrossato dall'azione del fuoco e contenente resti faunistici e ceramica da fuoco (testelli e olle) oltre che un frammento di maiolica arcaica blu (XIV secolo).

Periodo 3: XIV-XV secolo d.C.

Ulteriori interventi di ristrutturazione portano all'inserimento in us 611 di una struttura (**US 608, fase 4**), di cui resta la fondazione in ciottoli legati da malta, larga circa 38 cm e conservata in altezza per appena 25-30 cm, poggiante direttamente sullo strato limoso us 616/b ed al parziale rifacimento della porzione centrale di 611 in laterizi di recupero e ciottoli. La fondazione us 608 si allunga verso sud per 3,60 m e si congiunge con un'altra struttura in ciottoli e malta, conservato sempre e solo a livello di fondazione, che, dato il maggior sviluppo in profondità, pareva costituire la base d'appoggio per un piccolo pilastro. Sullo stesso allineamento, procedendo verso sud, si trovano le tracce di una struttura (**US 607**), quasi completamente asportate, che costituiva il prolungamento di 608 e 644, andanti a congiungere in corrispondenza di us 645 con il perimetrale meridionale. [**US 644** è la base di appoggio del piccolo pilastro]. Nella parte sud occidentale dell'area viene costruita un'altra struttura (**US 609**) in laterizi, ciottoli e malta, larga 30 cm e lunga 2,61 m, orientata nord-sud, terminante a nord con una base quadrata di 38×33 cm su cui sono ancora conservati i residui metallici di un cardine; tutta la cresta di rasatura della struttura è coperta da un letto irregolare di malta grigia. La fossa di fondazione di un 609 (**US -629**) taglia a est l'us 616 ed a ovest l'us 626 (f.2), uno strato limo argilloso spesso pochi centimetri caratterizzato, come l'us 617, da vistosi arrossamenti da fuoco, che copre a sua volta uno strato limoso (**US 628**, f.2) assimilabile a us 616.

Periodo 2: XVI-XVII secolo d.C.

Nella porzione sud orientale dell'area si assiste un'ulteriore ristrutturazione (**fase 3**): in appoggio ad us 611, viene realizzata in laterizi e pietra una struttura rettangolare (**US 610**) a vasca ampia internamente 230×90 cm. Le imponenti spallette della costruzione, di larghezza irregolare, utilizzano laterizi e pietre ma anche materiali di reimpiego come ad esempio un frammento di fusto di colonnino in marmo, murato nell'angolo sud occidentale. La datazione della struttura è circoscrivibile, sulla base delle ceramiche restituite dalla fondazione di 610 (**US 624**) e dall'**US 620**, una sorta di sistemazione con laterizi e pietre dello spazio compreso tra la struttura 610 e l'us 608, al XVI secolo e la sua funzione più probabile è quella di pozzo nero. Inoltre, viene compiuto uno scasso (**US -618**) lungo il perimetrale orientale, forse per un restauro della struttura muraria (**US 619**). Nella parte nord orientale del vano sono realizzate due strutture: **UUSS 641 e 642**. La prima è formata da due muri in laterizi e pietre che delimitano una superficie rettangolare di 360×150 cm, in corrispondenza dell'angolo nord/est del vano. Nel perimetrale est dell'area, conservato in questo tratto nella sua veste basso medievale di laterizi, si notano alla quota di 10 cm, sopra la cresta di rasatura di us 641, nove cavità rettangolari di 13×15 cm, realizzate in rottura del paramento, destinate probabilmente all'alloggiamento di travature lignee funzionali alla copertura della sottostante struttura us 641. Dal riempimento (**US 643**) dello spazio interno all'us 641, a matrice sabbiosa di colore grigio scuro, provengono ceramiche della seconda metà del XVI secolo. Effettuando un piccolo approfondimento nella porzione meridionale della struttura, sotto il riempimento us 643, si ha, a partire da quota -85, uno strato di limo argilloso di colore marrone (**US 647**) spesso una decina di centimetri, che copre a sua volta un livello argilloso arrossato dall'azione del fuoco (**US 649**) interessato da alcune buche sub circolari (**US 650**) riempite con argilla e limo contenenti frammenti di laterizi e pietre. La struttura sub-quadrangolare in laterizi us 642 (100×137 cm), in origine voltata a pien centro, appare riempita di materiale macerioso, ed anche se non è stata indagata internamente, a causa della forma caratteristica è interpretabile come un bottino.

Periodo 1: XVIII-XX secolo d.C.

L'**US 605** (quota -25/-30, **fase 2**), uno strato a matrice sabbioso limosa ricco di frammenti e laterizi, costituiva il riempimento soprastante alle creste di rasatura delle varie strutture, ed ha restituito in abbondanza materiale del XVII e del XVIII secolo. All'interno di 610 il riempimento (**US 621**) costituito da un sedimento di colore marrone-grigio macerioso, ha dato ceramica della seconda metà/fine del XVIII secolo e segna la definitiva oblitterazione del bottino. Lungo il perimetrale est correva una canaletta (**US 604**) simile all'us 502 dell'area 500, ma di cui al momento dell'intervallo di scavo non restavano che labili tracce sulla muratura dello stesso perimetrale orientale.

Uno strato di ghiaia e ciottoli (**US 602, fase 1**) coperto da una soletta di cemento (**US 601**) costituivano il piano pavimentale, realizzato nel XX secolo, che oblitterava lo strato 605 al momento di inizio lavori nell'ottobre 2005.

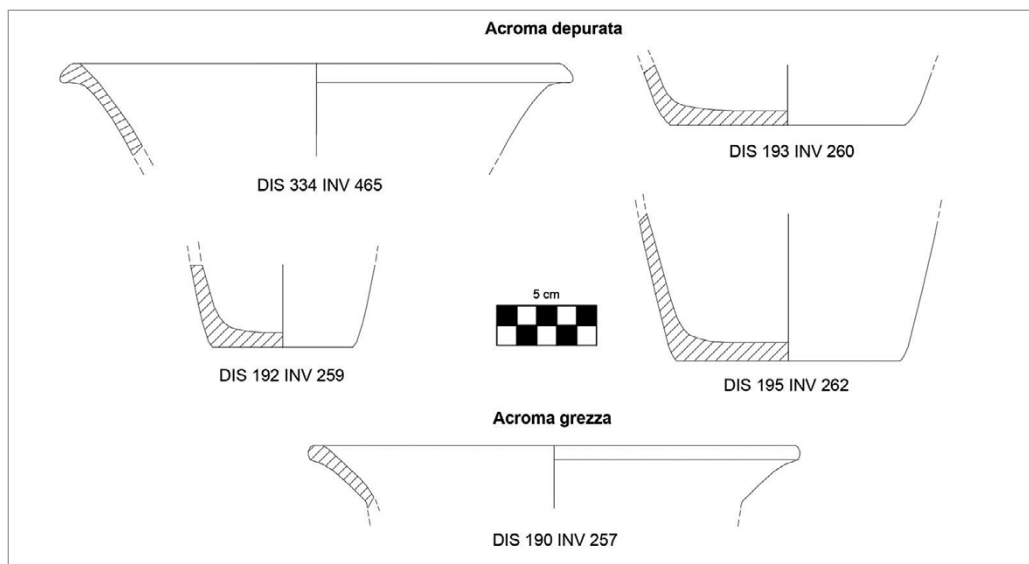


fig. 9. Frammenti ceramici di acroma grezza e depurata in fase con la costruzione del muro USSMM 716, 710.

4. Conclusioni

Il contesto oggetto di studio è stato scelto in quanto identificato da Ciampoltrini come sede di un “muro appartenente a una struttura pubblica di epoca bizantina”, che potrebbe essere stato adattato, con l’arrivo dei Longobardi, per ospitare l’amministrazione del *dux* (Ciampoltrini 2011, p. 55). Si è ritenuto quindi essenziale, per comprendere meglio le aree del potere pubblico cittadino, condurre un’analisi approfondita della stratigrafia e dei materiali ceramici rinvenuti.

Sebbene le fonti scritte collochino la corte marchionale nell’isolato compreso tra via San Paolino, via del Crocifisso, via Vittorio Emanuele II e Piazzale Verdi, l’evidenza archeologica non ha finora fornito elementi databili con certezza al periodo compreso tra X e XII secolo d.C., periodo in cui, dovrebbe essere presente il centro di potere nell’area. È importante, però, considerare che i saggi di scavo condotti nell’attuale Hotel San Luca Palace non hanno potuto raggiungere notevoli profondità né estensioni significative. Tuttavia, dai dati stratigrafici e dai reperti ceramici rinvenuti, emerge che le USS in fase con il muro USSMM 710-716, datato da Ciampoltrini al VI secolo², presentano anche materiali pienamente medievali, tra cui un’olla del XII-XIII secolo d.C. (Numero di disegno 190, fig. 9), simile ad altri esemplari ritrovati in vari contesti cittadini (Cantini et alii 2021). Non è possibile, quindi, affermare con certezza che il muro in questione appartenesse al centro del potere marchionale, poiché mancano indicatori archeologici specifici per una datazione e un’interpretazione definitiva.

² Ciampoltrini 2011, p. 54. Lo studioso menziona, anche in tavola, la presenza di frammenti di sigillata africana, lucerne e vasi a listello databili al VI secolo; tuttavia, questi reperti non risultano presenti nei depositi della Soprintendenza per i Beni Archeologici e Paesaggistici delle province di Lucca e Massa Carrara.

Bibliografia

- Abela, E. (1999). Lucca. in Gelichi, S. (a cura di). *Archeologia urbana in Toscana. La città altomedievale* (pp. 23- 44). S.A.P.
- Abela, E. & Bianchini, S. (2002). *La città nascosta. Venti anni di scoperte archeologiche a Lucca. Catalogo della mostra. Lucca 1 maggio-23 giugno 2002*, Lucca.
- Belli Barsali, I. (1973). La topografia di Lucca nei secoli VIII-XI. in *Atti del V congresso interazione di Studi sull'Alto Medioevo. 3-7 ottobre 1971. Lucca e la Tuscia nell'Alto Medioevo* (pp. 461-552). Centro italiano di studi sull'alto medioevo.
- Belli Barsali, I. (1988). *Lucca. Guida alla città*, Pacini Fazzi.
- Bratchel, M.E. (2008). *Medieval Lucca and the Evolution of the Renaissance State*. Oxford University Press.
- Cantini, F. et alii. (2021). Nuovi dati sull'area della corte regia di Lucca e sulla zecca urbana: una rilettura della sequenza stratigrafica e dei reperti ceramici dello scavo di Piazza San Giusto (VI-XVI secolo). *Archeologia Medievale*. XLVIII. pp. 213-261.
- Ciampoltrini, G. (1999). La trasformazione urbana a Lucca tra XI e XIII secolo: contributi archeologici. *Archeologia Medievale*. XIX. pp. 701-728.
- Ciampoltrini, G. (1997). Archeologia lucchese d'età comunale: le mura urbane e le terre nuove. *Archeologia Medievale*. XXIV. pp. 445-470.
- Ciampoltrini, G. (a cura di). (2005) *I giardini sepolti. Lo scavo degli orti di San Francesco in Lucca*. Cassa di Risparmio di Lucca.
- Ciampoltrini, G. (2006). Nidus tyrannidis. Contributi archeologici per l'Augusta di Casdtruccio in Lucca. *Archeologia Medievale*. XXXIII. pp. 223-237.
- Ciampoltrini, G. (2011). *La città di San Frediano. Lucca tra VI e VII secolo: un itinerario archeologico*. Tipografia la Grafica Pisana.
- Ciampoltrini, G. (2013). *Bianco conventuale. I servizi da mensa del San Francesco di Lucca tra XV e XVI secolo*. Cassa di risparmio di Lucca.
- Ciampoltrini, G. (2014). Il contributo dell'archeologia alla definizione del contesto urbano medievale lucchese. in Bozzoli, C. & Filieri, M.T. (a cura di). *Scoperta armonia. Arte medievale a Lucca* (pp. 35-59). Cassa di Risparmio di Lucca.
- Ciampoltrini, G. & Abela, E. & Bianchini S. (2006). *Nella terra, nel tempo: gli scavi archeologici nel complesso Galli Tassi di Lucca. Atti del convegno. Lucca, Villa Bottini, 10 maggio 2004*. Cassa di risparmio di Lucca.
- Ciampoltrini, G. & Saccocci, A. (2019). Dalla città marchionale a quella comunale. Lucca nel XII secolo: lo sguardo dell'archeologo e del numismatico. in Cantini, F. (a cura di). *Costruire lo sviluppo* (pp. 9-19). All'insegna del giglio.
- Ciampoltrini, G. & Spataro C. (2005). Lucca. Scavi in area urbana. *Notiziario della Soprintendenza per i Beni Archeologici della Toscana*. I. pp. 28-37.
- Ciampoltrini G. & Zecchini M. (2002). *Palazzo Arnolfi in Lucca: materiali per l'archeologia e lo storia della città dal medioevo al tardo rinascimento*. Cassa di Risparmio di Lucca.
- Mattei, F. (2019). *Lucca capitale della Tuscia nell'alto Medioevo: dal VI all'XI secolo*. Cassa di risparmio di Lucca.
- Oppedisano, F. (2022). *Between ostrogothic and carolingian Italy. Survivals, revivals, ruptures*. Firenze University Press.
- Seidel, M. & Silva, R. (2007). *Potere delle immagini, immagini del potere: Lucca città imperiale: iconografia politica*. Marsilio.

Ben Jervis*/§, Kate Autumn Evetts*, Benjamin Morton*

* School of Archaeology & Ancient History, University of Leicester, UK.

§ Corresponding author (bpj4@leicester.ac.uk).

DECLINE AND REGENERATION IN MEDIEVAL ENGLISH TOWNSCAPES

Abstract: Long-running debates about the extent to which towns in later medieval England suffered from a process of ‘decline’ in the later 14th and early 15th century have traditionally been dominated by historical evidence, from which relative wealth and population have been calculated. Archaeological analysis offers an opportunity to take a different approach to this question, by comparing patterns of regeneration both within and between towns. This paper explores this potential in relation to three small towns in

eastern England; Maldon (Essex), Thaxted (Essex) and Huntingdon (Cambridgeshire). By reconstructing patterns of regeneration through excavated remains and the occurrence of standing buildings we propose that archaeology serves to demonstrate the complexity, and highly contextualised character, of urban development in this period.

Keywords: Medieval England, urban archaeology, burgrave cycle, urban decay, 14th century crisis.

1. Introduction

The period between c1100-1300 saw a process of urbanisation in England, with the growth of around 600 small towns (see Dyer, 2003). The circumstances of urbanisation were highly varied. Some towns developed out of existing settlements, with their plan often combining irregular plots around an early core (typically a church), with the addition of planned burgrave plots lining the principal streets, as at Stratford-upon-Avon (Warwickshire) (Carus-Wilson, 1965; Dyer, 2003, p. 95). In other cases, newly planned towns were laid out, for example the monks of St Osyth cleared an area of woodland on the main route between London and Colchester to establish the new town of Braintree (Essex) (Beresford, 1967, p. 434). The form of these towns ranges from ribbon settlements strung out along main routes, as at Braintree, to planned grids, as seen at Winchelsea (East Sussex). It was not only the topography of these towns which was varied, but also their size and economic base. The distinction between urban and rural was not sharply defined (see Jervis, 2025), with small town households often being engaged in agriculture alongside commercial



fig. 1. Location of case study towns. Image: Authors.

or artisanal activity and, critically, these towns were established within the context of a manorial economy; ultimately the motivation for their foundation was the generation of revenue from rents, tolls and fines levied on the urban community (Beresford, 1967, pp. 55-59; Goddard, 2011).

The early and mid-14th centuries were a period of profound challenges (see Campbell, 2016 for a broad overview). Climatic change caused an agrarian crisis, with both crop failures and zoonotic disease. In 1348 the Black Death reached England. These crises have set the scene for extensive debate about the decay and decline of towns in this period (see Dobson, 1977; A. Dyer, 1991; C. Dyer, 2015; Jervis, 2017; Lilley, 2000a). England's population certainly decreased, perhaps by up to a half, and this pattern is common to town and country, although it is probable that the proportion of the population living in towns remained relatively stable (Dyer, 2002, p. 5). Debate over urban fortunes has been characterised by polarised positions based on limited evidence; for example some see buoyancy in the undertaking of public works such as the rebuilding of churches or civic buildings (Bridbury, 1981) whilst others see decline in the fall in the proportion of taxable wealth held by urban communities (Dobson, 1977). What is clear is that urban decline was by no means a universal phenomenon, both Lilley (2015) and Jervis (2017) present instances of suburban expansion, for example at Alton (Hampshire). The period is perhaps better characterised in terms of an adjustment and recalibration of the urban sector, whereby urban communities did not feel the impacts of crisis, nor respond to them, in a uniform way. Analysing towns in southern England, Jervis (2017) highlights the importance of the relationship of towns to their rural hinterland and lordship. Investigations have typically focussed on the relative fortunes of towns, identifying movements in relative wealth and population size (e.g. Dyer, 1991) and comparisons of evidence for indicators of decay and decline (e.g. Jervis, 2017). Here, we take a different approach, exploring transitions within individual towns to better understand how the crises of the 14th century impacted upon urban life. We focus on the data from excavations in three towns in eastern England; Huntingdon (Cambridgeshire), Maldon (Essex) and Thaxted (Essex) (fig. 1), chosen because they have been subject to intensive excavation and possess surviving medieval buildings.

2. Approaching Medieval Townscapes

The study of medieval townscapes is a well-established element of urban archaeology and historical geography. Applications of plan analysis, whereby the development of the townscape is pieced together from analysis of historic maps by identifying the relationships between plan units (areas of the street plan and plots which appear to have been laid out together) have developed a detailed understandings of the processes of urban change (e.g. Lilley, 2000b), whilst comparative analysis has permitted both considerations of the process of planning (Lilley 2001; 2015) and contemporary perceptions of these landscapes (Slater, 2005). In England, the plan analysis methodology was first applied to a medieval town in Conzen's (1960) analysis of Alnwick (Northumberland), which identified several phases of urban planning. Through this

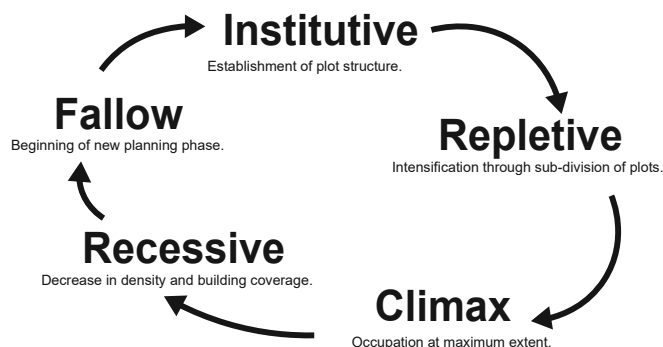


fig. 2. The burgage cycle.
Image: Authors.

work, Conzen (1960, pp. 92-94) also developed the concept of the ‘burgage cycle’ characterised as the progressive infilling of back yards as urban populations increase, with these being cleared and redeveloped (fig. 2). Whilst typically laid out in a regular manner, plots within medieval towns were often not stable in their form, with there being evidence both for the sub-division of plots and their amalgamation (or engrossment). For example, at Stratford-Upon-Avon in Warwickshire a mid-thirteenth century borough rental, drawn up some 50 years after the foundation of the town, shows that many of the original burgage plots had been subdivided into halves and thirds, while others were held jointly in twos or threes. The process of plot division was undertaken by burgesses and not by officials of the lord (Carus-Wilson, 1965, p. 58).

From this perspective, we can think through changes to the urban landscape in the 14th and 15th centuries not as a process of ‘decline’ but as part of an ongoing regenerative cycle. Archaeological contributions to the decline debate have been limited, in part due to the evidential challenges of this period. Astill (1985; 2000) highlights changes in waste disposal practices, resulting in a lower density of cut features and associated material culture, as a particular challenge. However, the substantial increase in archaeological investigation in small towns since changes in planning policy in England in 1990, which made archaeology a material consideration in the planning process, have resulted both in a substantial increase in the available data and in the number of towns investigated. Critically, we argue that the occurrence of cultivation soils and open spaces in towns need not be evidence of ‘decline’ but rather of change in urban lifeways, as space came to be used in new ways. For example, Dimmock (2014) has highlighted how the leasing and enclosure of rural land from c1400 resulted in the dispossession of townspeople’s agricultural holdings, which we might expect to have resulted in increasing usage of open space within towns for agricultural and horticultural production. Rather than declining, we can perceive of urban life as adapting and changing to socio-economic circumstances, allowing urbanisation in the post-Black Death period to become something different to that of the preceding century (see also Jervis, 2017; 2023; 2024).

Whilst excavated archaeological evidence might indicate periods of abandonment or non-residential activity on burgage plots, standing buildings offer a different perspective (see Pearson, 2009). Domestic buildings pre-dating 1400 are exceptionally

rare survivals in the urban landscape, but the later medieval period is characterised by a process of rebuilding, with the introduction of new house forms and the alteration of existing structures (Johnson, 1996; Briscoe et al, 2018). Once situated in the period c1550-1650, the use of dendrochronology has demonstrated that this 'great rebuilding' extends backwards into the 15th century and occurred at different times in different parts of the country (e.g. Roberts, 2007). In order to understand changes in the townscape it is necessary to combine both excavated evidence and that of standing buildings to understand the cycles of (re)development taking place in small towns.

3. Cycles of Regeneration: Evidence from Eastern England

Analysing the fortunes of small towns in southern England, Jervis (2017) proposed two broad models for change in the urban landscape. The first, exhibited by places such as Andover (Hampshire) saw the contraction of the town towards its core as the population declined and relatively recent suburban expansion was abandoned. This is a process which can be seen vividly at Wimborne (Dorset) where a short-lived 13th century planned extension appears to have been entirely abandoned by the 15th century (Field, 1973). The second is a more piecemeal process of abandonment, whereby vacant plots open up within the townscape, sometimes being merged together to create larger ones. Such a pattern can be seen at Lymington (Hampshire) for example. These processes are not mutually exclusive, for example the port town of Winchelsea (East Sussex) saw an apparently planned contraction combined with the engrossment of plots within the occupied area of the town (Lilley, 2015; Martin and Martin 2004, pp. 98-100).

Here this approach is developed through exploring the histories of excavated plots within three towns in eastern England. Working at the scale of the plot, rather than the townscape, capitalises on the strengths of archaeological evidence to provide detailed 'keyhole' insights into townscapes, in contrast to approaches grounded in plan analysis which are better suited to assessing change at the townscape scale. The analysis is based upon a dataset of archaeological interventions in these towns derived from searches of the Essex and Cambridgeshire Historic Environment Records (HERs), which are databases of all archaeological sites and monuments and interventions (usually referred to as 'events') within a particular area (see supplementary dataset). Both HERs are held and maintained by the associated County Council, as the local planning authority.

Maldon, Essex

Maldon is situated on the Blackwater estuary and was a small port town. It was established as a burh (defended proto-urban settlement) in AD 916 and a small market town developed along the High Street, which runs towards the hythe (landing place) (Petchey, 1991, p. 7). In the 11th century Maldon was the second most important town in the county, having three parish churches, two of which saw extensive work in the 15th century. The prosperity and significance of the town is demonstrated by

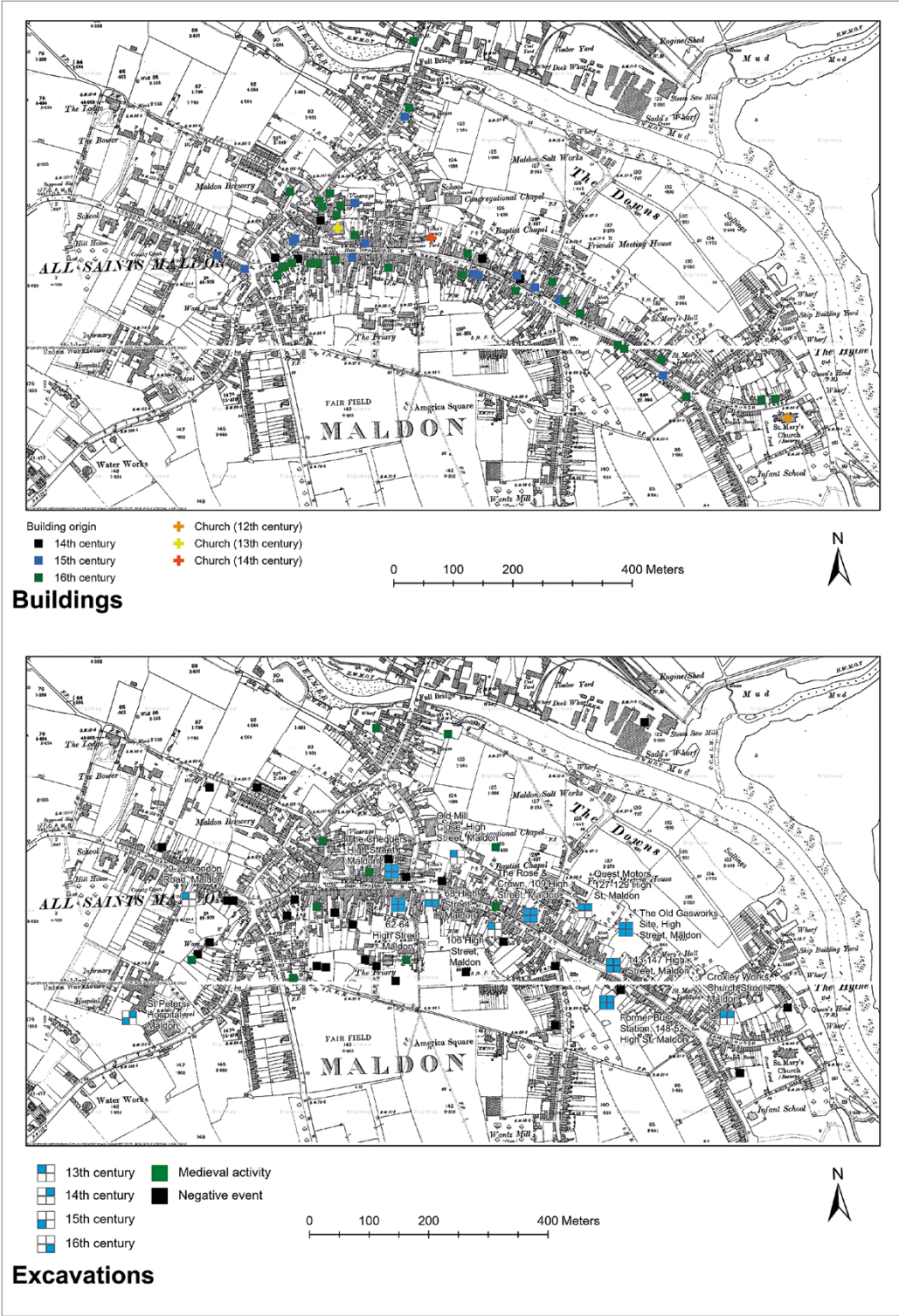


fig. 3. The distribution of medieval buildings and archaeological sites in Maldon. Image: Authors.

the foundation of a friary by 1292 and a suburban hospital in 1164 (see Essex County Council, 1999a for overview). Surviving 14th-16th century buildings within the town include several 'Wealden' houses, a distinctive form of domestic architecture dating to the 15th century and indicative of a period in the transformation of domestic space from open hall houses to multi-roomed dwellings (Andrews & Stenning 1989; 1996) (fig. 3). Around 1500, Maldon probably ranked as the third town in Essex by population and wealth, with estimates of per capita wealth suggesting relative prosperity, however by the mid-17th century it appears to have fallen down the order considerably, probably due to a relative lack of involvement in the textile industry as well as the decay of the harbour and political conflict within the town (Petchey, 1991, pp. 11-14). However, this picture of decay is tempered by other evidence, for example there was a fairly continuous, and increasing, flow of registrations to become a freeman of the town and in the mid-16th century around three-quarters of these are likely to be migrants into Maldon (Petchey, 1991, p. 15).

Excavations in Maldon reveal a mix of piecemeal abandonment and contraction. The town appears to have been polyfocal in form, with four clusters of activity. The first cluster was around the marketplace, the second ran down the main street towards the hythe, the third is the hythe itself and the fourth is an area extending to the north of the marketplace, which had developed by the 12th century (Petchey, pp. 1991, 7-9). Archaeological excavation has focussed on the first two areas but this piecemeal development, likely relating to early medieval settlement foci, means that we should anticipate a patchy urban landscape with varied land use from the earliest phases of urban activity.

At the western end of High Street, around the marketplace and All Saints Church, excavations at 60 High Street (Harding, 2019) and 62-64 High Street (Bassett, 1972) provide clear evidence of continuous occupation and regeneration of burgage plots within the core of the town. At both sites, late Saxon timber buildings were present, which were subsequently altered through the 12th and 13th centuries, with the building at 60 High Street possibly being destroyed by fire in the early 13th century. A new building on the street frontage was constructed at 62-64 High Street around the late 13th or early 14th century, with the existing detached kitchen perhaps also being rebuilt. A floor surface at 60 High Street attests to a similar process of rebuilding, but whereas the structure at 62-64 High Street appears to have remained in use until its destruction by fire in the early 15th century, that at 60 High Street appears to have fallen out of use in the later 14th century, at which point waste, including demolition material, was dumped on the site. New structures were built on these sites in the later 15th century. The archaeological sequence therefore points to brief periods of hiatus in occupation, but relatively rapid redevelopment.

The rebuilding of structures in this area corresponds with the evidence for standing buildings (fig. 3). Most notable are the semi-detached Wealden houses, dated to the 15th century, known as the King's Head. These buildings, at the western end of the marketplace, are likely a speculative development by the Bouchier family (Andrews & Stenning, 1996). These are three bay structures, two of which were jettied, the easternmost of which appears to have been divided into a shop to the front and a parlour or service room to the rear. A dark earth deposit identified during archaeological

observations to the rear may indicate that this redevelopment followed a period of abandonment, similar to that proposed at 60 High Street. The King's Head is opposite a further building dating to around 1400, known to be a substantial residential building (Essex County Council, 1999a, p. 22). Whilst this period clearly saw rebuilding in the core of the town, it also saw modification of older buildings, as indicated by the jettied range to the rear of 1-3 High Street, a building originally dating to c1300. Speculative development and rapid rebuilding attest to pressure on housing in the later 15th and early 16th century, driven in part by migration into the town (Petchey, 1991, p. 88).

Further east, urban development does not appear to have started until the later 12th or early 13th century, with there being sparse evidence of early medieval activity. Here, the plots show a mix of developmental trajectories and a high degree of variability in the nature of the activity represented. Petchey (1991, pp. 85-88) draws attention to the fact that the town had little scope for expansion due to the importance of surrounding productive land, with gardens, orchards and yards being highly prized and effectively limiting scope for extensive development in some areas. The Bus Station site (148-152 High Street) conforms to what we might expect of a narrative of urban decline (Ennis, 2015). Here there was a late Saxon building which may have persisted into the 1100s, with a new building being erected on the site in the later 13th century. Several cess pits are present on the site associated with these structures. It is unclear if the building continued in use into the 14th century, but the presence of demolition materials in the later medieval pits perhaps points to its destruction, with this site, situated at the periphery of the western extent of the town, reverting to cultivation. A similar developmental trajectory is evidenced at Quest Motors (127-129 High Street) (Carew, 2007). Here a particularly high density of pits, situated at the rear of properties fronting High Street and associated with boundary features, point to intensive occupation until the mid-14th century, after which the site reverts to horticulture. However, at the nearby Gas Works site there are a low density of features, but a relatively unbroken sequence of activity on the basis of ceramic evidence (Medlycott, 1993). Similarly, at the Croxley Works, Church Street, similarly dense backland activity, with evidence for iron smithing in the vicinity, gave way to a build-up of topsoil, indicating cultivation activity from the mid 1300s (Ennis, 2009).

However, this evidence of contraction is tempered by that for continued occupation at 143-147 High Street (Brooks & Wightman, 2010). Here, occupation began in the 12th centuries, with multiple phases of timber building being identified. At some point in the 15th century, a time of increasing population pressure, the plot was sub-divided, although the earlier timber buildings seem to have remained standing into the 16th century. During this 15th-16th century phase, a barrel-lined pit was in use, the fill of which contained cobbling waste. Similarly, at the Rose & Crown (109 High Street) a 12th-14th century boundary ditch was respected by buildings erected on the street frontage in the 15th century (Ennis, 2016). Unlike at other sites on High Street, there was a relative sparsity of cut features in this area, although quarry pits were excavated during the 15th-16th centuries. This process of regeneration and, perhaps, intensification, speaks to the entrenched patterns of land use, in which open ground could be repurposed for productive purposes, necessitating the need for the sub-division of plots elsewhere.

Whilst later medieval standing buildings are clustered in the core area of the town, a number are distributed along High Street. Of particular significance are the pair of Wealden houses at 160-164 High Street. These are interpreted as a speculative development, given the relatively poor quality of their carpentry and the 'showy' design of the frontage (Andrews & Stenning, 1989, 108). Here, a watching brief identified a similar stratigraphic sequence to that observed at 60 High Street, with earlier occupation being sealed by a deposit suggesting a brief hiatus, followed by the erection of the new buildings (Andrews & Stenning, 1989, p. 107). This sequence suggests a piecemeal approach to regeneration in this area, with some vacant plots perhaps being acquired for speculative development, a process which might also be evident in the sub-division seen at 143-147 High Street and others being given over to horticulture. Further evidence for changes in land use in this part of the town is seen in the 15th century building at 90-94 High Street which has been interpreted as a purpose-built warehouse (NHLE 1256860), indicating that development for non-residential purposes was also occurring around this time.

Attending to the occupational history of specific plots through excavated and standing buildings reveals that Maldon's transformation in the later medieval period does not follow a simple model of contraction of piecemeal abandonment, nor do plots circulate through a general developmental cycle. Whilst a general trend towards contraction can be seen from excavated sequences, and horticulture became an increasingly important form of land use, there is evidence for continued use and, perhaps speculative, redevelopment of some plots at the western end of the town, as well as sub-division. This supports the evidence for migration bolstering the population and sustaining Maldon's economic buoyancy, with there being evidence for both redevelopment and speculative investment, as well as adaptation through the turning of some plots over to horticultural use. Whereas some plots were relatively lightly occupied and reverted to horticulture, on others, most noticeably at 60 and 62-64 High Street, relatively intense occupation is sustained over several centuries, albeit interspersed with brief periods of hiatus, possibly caused by fire. Whilst the driver for some of this development may have been decay; the sequences from these sites, as well as that from 143-147 High Street and the standing building at 1-3 High Street suggest the modification of standing buildings rather than their purposeful demolition and rebuilding.

Thaxted, Essex

Thaxted, situated in north-west Essex, was granted a market in 1205 and recognised as a borough by 1348, at which time there were 90 houses and 36 shops (Newton, 1960, p. 20). The town is best known as a centre of the cutlery industry; the 14th century poll tax lists 79 cutlers, 11 smiths and 4 sheathers in the town (Newton, 1960, p. 21) and 'Thaxted Ware' knives were a well-known and desirable product in medieval England. The town appears to have expanded with the industry in the 13th and 14th centuries and declined with it in the 16th century. Decay is indicated by a reduction by half in the number of houses held in burgage tenure by 1593 (Newton, 1960, p. 27). The industry generated substantial wealth, seen in the 14th and 15th

century works to the church, the 15th century guildhall and merchants' houses. Despite the town having borough status, those with burgage status did not settle in a spatially contiguous area, with a survey of 1393 recording the presence of burgesses and non-burgess free holders occupying neighbouring plots (Newton, 1960, p. 23). This indicates a mix of artisans and those living off the land among the community, with potential implications for patterns of land use within Thaxted. Through the later 14th and early 15th century the number of plots held in burgage tenure increased which, coupled with the leasing of the manorial farm and the general removal of labour service in favour of cash, gave the manor an increasingly 'urban' character. This period also saw the leasing of small parcels of agricultural land around the town, butting on to domestic plots, to form new garden or yard areas (Newton, 1960, p. 26-27). The presence of apparently unoccupied land need not be indicative of abandonment but may, in fact, be an indicator of urban expansion as new land became incorporated into urban properties. Archaeological excavations in the town have recovered substantial evidence of the cutlery industry in the form of bone offcuts and metallurgical waste (Andrews, 1989; Pooley, 2016).

The town has a linear form, being laid out along a ridge with the church and marketplace at the west end (fig. 4). Weaverhead Lane is a back lane which runs parallel to this street. Unlike Maldon, where there is a background scatter of early medieval artefacts and features, excavated sequences in Thaxted begin in the 13th century. Investigations have focussed around Town Street and Weaverhead Lane. When combined with the evidence of standing buildings, excavation data contradicts a simplistic narrative of growth and contraction. This process can only be clearly observed at Weaverhead Lane. Here, a possible building and associated features containing dumps of material associated with the cutlery industry dating to the later 14th and early 15th century, sealed by a levelling layer, after which point the site was likely used for horticulture (Andrews, 1989). However, further work in this area identified a medieval ditch and retaining wall associated with a plot, with a robbed-out construction cut implying the presence of a later 15th or 16th century building (Medlycott, 1996). At 34 Weaverhead Lane there is evidence of fairly low intensity activity throughout the period, presumably in the backland of a property fronting Town Street. Here a boundary ditch appears to have been maintained into the later 15th or early 16th century, with there being a barrel-lined pit to the rear containing 16th century material (Ashworth, 2002). Clear evidence of continued occupation can be seen in the sequences excavated at Orange Street, where there are pits dating from the 13th-14th, 14th-15th and 15th-16th centuries, with continued pitting and ditching into the later part of this period, at 34 Town Street (Pooley, 2016). The excavations have all been small in scale and assessing the intensity of activity is problematic, however there is substantial evidence for continued activity on excavated plots within the core of the town.

Of particular interest are developments at Thaxted's southern and northern peripheries. At Park Street, at the southern periphery, there is limited evidence of 14th century occupation in the form of a clay-lined pit, but the majority of evidence here is indicative of dumping onto a surface midden (Roy, 2004). However, at Mill End there is a more complex picture (Forshaw, 2017; Carvey, 2019). Two main areas were excavated here, both of which provide evidence of 14th-15th century activity in the

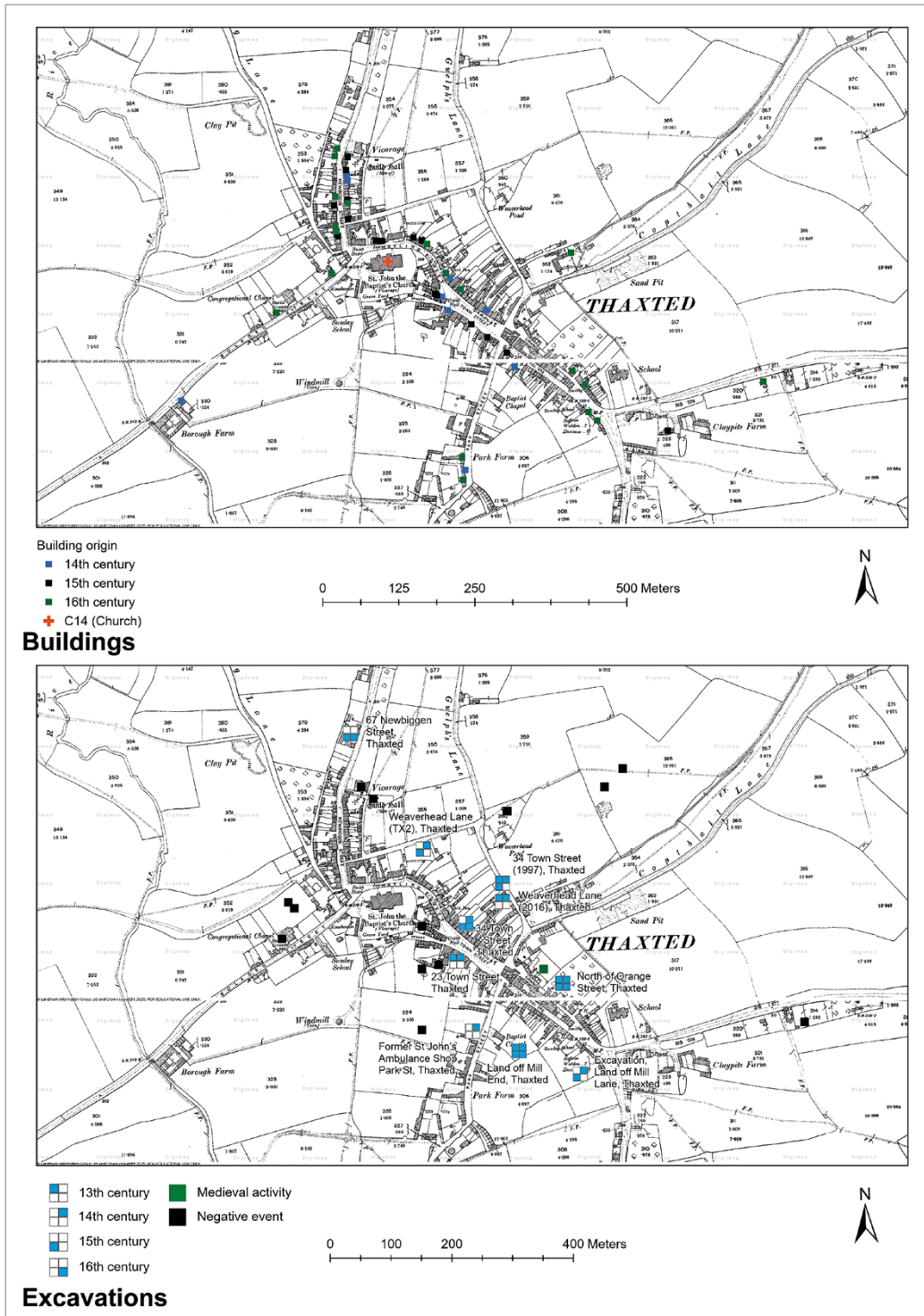


fig. 4. Distribution of medieval buildings and archaeological investigations in Thaxted. Image: Authors.

form of pits and ditches containing a mix of domestic and industrial waste. The upper fill of the ditches contains 16th-17th century material, implying they remained in use until that period. In the southernmost excavation area, a soil horizon built up suggesting reversion to horticultural use, however in the northernmost area, to the rear of standing 16th century buildings, pits continued in use into this period. This excavation demonstrates how patterns of land use can be highly variable within very small areas, and the selective excavation of urban plots might conceal evidence for continued low intensity use of backland sites. At the northern end of the town, Newbiggen Street was established around the 14th century and at 67 Newbiggen Street the earliest excavated evidence comprises pits of 15th-16th century date (Ennis, 2010) and there are several standing 15th and 16th. century buildings in this area (Figure 4).

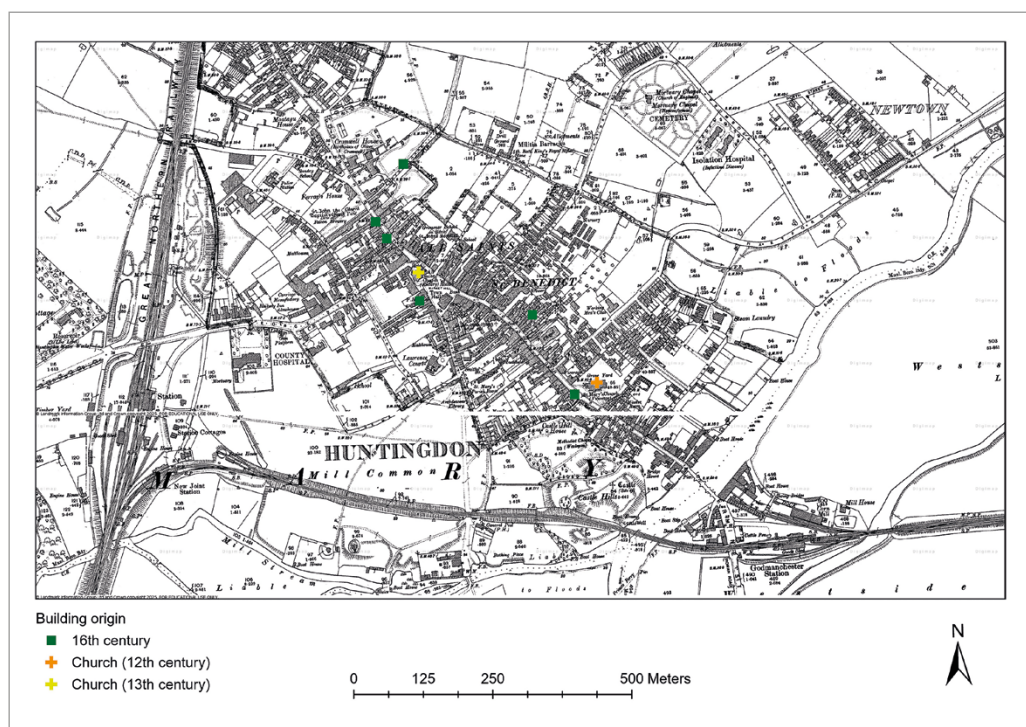
The standing building evidence complements the archaeological picture. Surviving 14th century buildings are clustered around Town Street, with the marketplace beginning to be infilled in the 14th-15th centuries, whilst 15th and 16th century buildings are primarily located in Newbiggen Street and Mill End. Rather than suggesting contraction to the core of the town, the standing building and excavated evidence points to continued development at the periphery of the town, with the focus of activity perhaps shifting from Town Street to Newbiggen Street as the cutlery industry declined and the cloth production rose to prominence.

The limited excavated evidence suggests that any abandonment of plots took place in a piecemeal fashion, as suggested by the excavated remains from Weaverhead Lane and Mill End. Overall, however, the evidence is suggestive of a low density of archaeological features extending across the period. Where change is evident it is in the reorientation of the town towards Newbiggen Street, probably a planned extension, but even this was not at the expense of new building at the opposite end of the town.

Huntingdon (Cambridgeshire)

Like Maldon, Huntingdon was established in the early medieval period, being situated at a crossing point on the River Great Ouse on Ermine Street, the Roman road running from London to York. In 1086 there were 256 burgesses and it is recorded that 20 tenements were removed for the erection of the castle in the 11th century, indicating that there was a substantial settlement here, comparable in size to Cambridge. The comparative size and complexity of the town is illustrated by the fact that in the 13th century here were 16 parish churches, as well as a sizeable Jewish population and multiple religious houses (Cambridgeshire County Council, 2015).

The only standing medieval buildings in Huntingdon are two churches, and six 16th-century survivals (fig. 5). However, both central and peripheral areas of the town have been subject to intensive archaeological investigation (fig. 6). Whilst there is evidence for early medieval occupation at several sites in the town, the archaeological evidence points to substantial expansion in the 12th and 13th centuries. Within Huntingdon's core, the excavation of new boundary ditches or gullies has been identified at St. Germain Street (Freke, 1999, p. 10), Town Centre (Clarke, 2004, p. 20), Ferrars Road (Greef, 2019, p. 37), and Edison Bell Way (Thatcher, 2019, p. 21), a process suggestive of changing land divisions and building density, possibly related



to an increased number of inhabitants and subsequent demand for partitioned or allocated space. Occupation at these sites within the core of the town is particularly intensive, with large number of pits and other occupation-related features dating to this period at most sites. Generally, there are hundreds more features dating to the high medieval period compared to earlier periods. This increase in domestic activity across the expanding town is also evidenced in the higher number of surfaces recovered, including yards and trackways such as at St. Germain Street (Freke, 1999) and Town Centre (Clarke, 2004). Extensive gravel quarrying activity in sites to the south of the historic town core, notably at two High Street sites (Williamson, 2005, p. 22; Clarke, 2005, p. 6), may reflect a need to level layers and create surfaces driven by a demand for usable space within the town following the construction of expanded occupation zones.

This period also saw expansion of the town into more peripheral areas and the intensification in the management of surrounding land. At Ferrars Road peripheral settlement on the line of Ermine Street appears to have been established around the time of the Norman Conquest with the division of land into plots. A second phase, dating to the 12th century, saw sub-division of these plots, suggestive of intensification in occupation (Greeg, 2019, p. 35). A similar high medieval reworking of property boundaries occurs at the nearby Edison Bell Way site (Thatcher, 2019, p. 23). The expansion of the town and its population is indicated in the reduction of the plot size compared to earlier periods, especially in this site on the northern edge of the historic

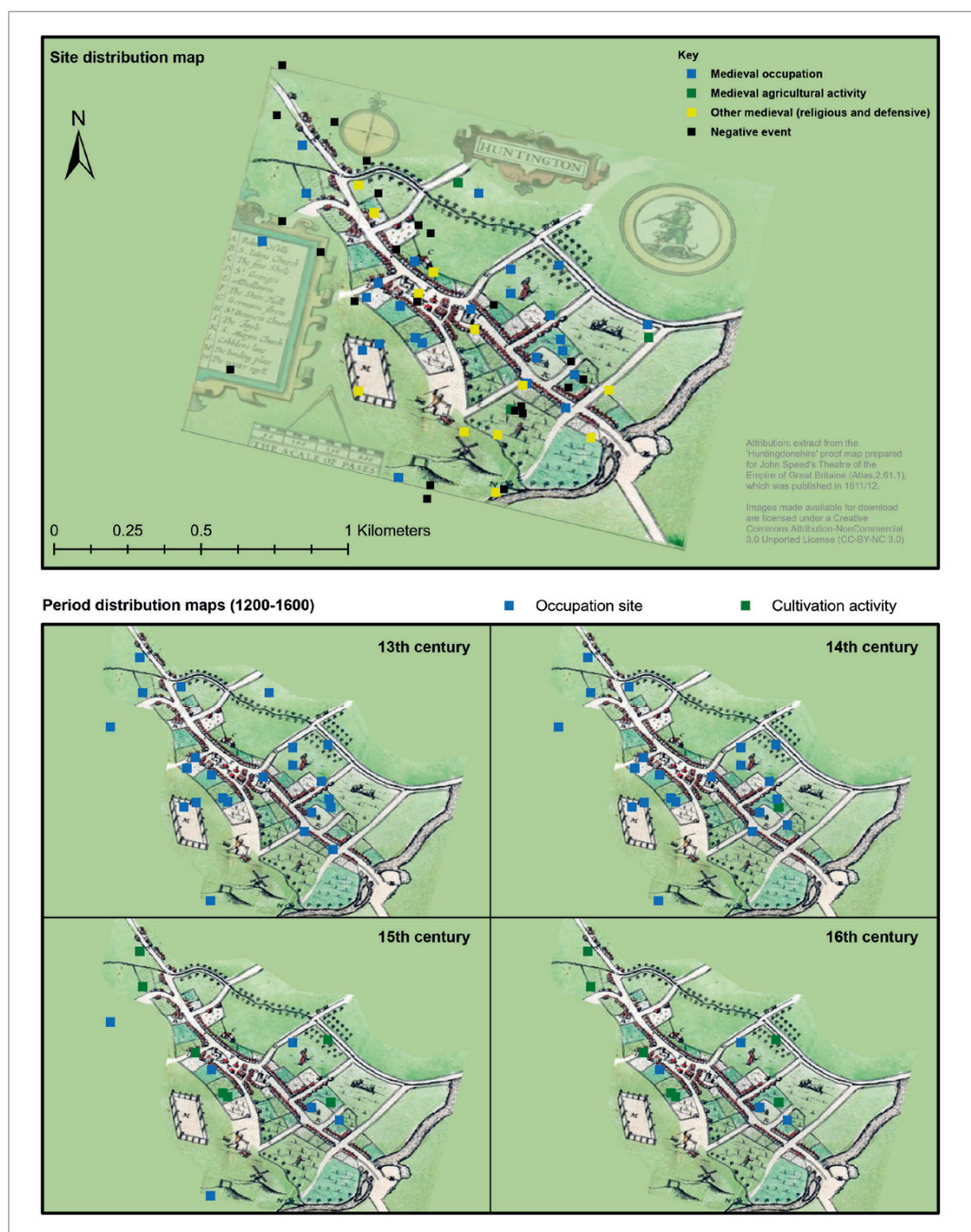


fig. 6. Distribution of dated archaeological evidence for occupation and horticultural activity in Huntingdon, overlain on to the 17th Century Speed Map of the town. Image: Authors.

town core. Excavated environmental remains, as well as the presence of tank-like vats suggests that this peripheral part of the town was particularly associated with comparatively intensive industrial production, most likely the processing of fibres and hides (Thatcher, 2019).

There are further indications of change within the core of the town. Wooden structures were erected within garden spaces at the Town Centre (Clarke, 2004, p. 23), St Germain Street (Freke, 1999, p. 10), and Royal Oak Passage (Hickling, 2005, p. 7) sites. Particularly, in the Town Centre, high medieval spatial reorganisation is evidenced as postholes were discovered underneath a later boundary ditch; suggesting that timber buildings were removed to make way for new property boundaries and land divisions. In turn, this reflects a high medieval demand for urban space following a period of economic prosperity and population growth.

Suburban growth is also indicated by the excavations at Chequers Court, where there is evidence for the establishment of burgage plots dating broadly from the 12th to 15th centuries. Beyond the area of settlement, the area seems to have been managed for agricultural production, with a network of drainage ditches being dug, draining downhill towards the river (Thatcher, 2013, p. 24). Environmental evidence, including plant remains and amphibian bones, confirms that this area was wetland. There is clear evidence for cultivation activity within a defined property boundary dating to the twelfth to mid-fourteenth century: well mixed, homogeneous soils contain evidence for well-established flora, as well as evidence for midden material being used as manure. This suggests that this area of the town was a dynamic landscape prone to flooding, which the community sought to manage by bringing into productive use. The drainage ditches represent a significant investment of time, knowledge, and energy to convert waterlogged land to arable soils. The evidence from this area of the town indicates a northwards expansion into previously marginal areas, converting land to agricultural production and a persistence of domestic activity to the south.

A strong case can be made that Huntingdon suffered from a decline in its fortunes, in part due to the broader crises of the 14th century but also due to local factors such as the decline of the St Ives Fair and a resultant reduction in traffic. In 1363 it was reported that around a quarter of the town was uninhabited, although the town was clearly still of some commercial significance in the 15th century when six Flemish merchants resided there (Cambridgeshire County Council, 2015, pp. 27-35).

This decay of the urban landscape is clearly apparent in the excavated archaeological evidence. There is a clear lessening in the intensity of activity at the peripheral sites at Edison Bell Way and Ferrars Road, with both sites likely being gradually abandoned, as illustrated by the slow infilling of pits (Thatcher, 2019, p. 44; Greef, 2019, p. 38), with the sites perhaps reverting to being open and unmanaged ground. Similarly, the previously cultivated area at Chequers Court was also abandoned, with evidence for gradual infilling suggesting the area fell into disuse as the settlement contracted (Thatcher, 2013, p. 27). Considering the knowledge and investment that was needed to maintain this wetland area to be viable for cultivation activity, this area may have been abandoned into the later fourteenth century as it became too difficult to sustain following substantial population loss.

Alongside the abandonment of peripheral sites, there is a general contraction of activity across Huntingdon as evidence for occupation appears only along major roads such as the High Street. Across the town, domestic waste disposal continued towards the rear of garden spaces, but there is also evidence for cultivation and backyard industry along street frontages. This contraction is visibly preserved into later centuries,

as documented in the large amounts of open space and buildings lining the streets in John Speed's map of Huntingdon, drawn in 1610 (Figure 6).

This change in land use is starkly evidenced in the archaeological record, with cultivation soils completely sealing earlier deposits at a number of sites in the town's core, including at St Germain Street (Freke, 1999, p. 7), Chequers Court (Thatcher, 2013, p. 10), Town Centre (Clarke, 2004, p. 36), and Walden House (Clarke, 2006, p. 21). These cultivation layers have yielded substantial archaeobotanical assemblages, usually preserved by charring, as well as evidence for manuring in the scattering of domestic waste. This drastic change in garden space use and activity close to the centre of the medieval town suggests that Huntingdon's inhabitants may have been increasingly concerned with food security.

Of the three towns discussed here, Huntingdon perhaps represents the most obvious picture of urban decay and decline and the evidence from the town centre mostly clearly adheres to the concept of a burgrave cycle of intensification followed by decay and regeneration. There is evidence both for the contraction of the settlement from peripheral areas and a lower intensity of occupation within the town centre, which appears to persist into the 16th and 17th centuries. However, as in Maldon, substantial areas of the town appear to have been converted for agricultural or horticultural use, with the evidence of Speed's map suggesting that this use persisted for several centuries (Figure 6). Such a marked and sustained change in land use implies that simply viewing this change through the lens of decay and decline conceals a shift in how urban space was inhabited and perceived in this period.

4. Discussion and Conclusions

Together, these three examples illustrate that a singular narrative of decay and decline is tenable neither for the urban sector as a whole or for the development of individual towns. Rather, these three towns each demonstrate distinct patterns of regeneration across their landscapes, in response to specific local circumstances. Whilst a model of contraction to the core can be convincingly argued for Huntingdon, this is less evident in Maldon and Thaxted. In both Essex towns, even at their maximum extent, the urban landscape was patchily occupied. Pressure for space extended beyond the need for housing, as demonstrated by the incorporation of agricultural land into plots at Thaxted and in the continued horticultural use of plots in Maldon, despite the sub-division of plots and speculative building indicating increasing demand for housing. A particular feature of Thaxted is a change in the focus of development from the area to the east of the marketplace, along Town Street, to the Newbiggen Street area, demonstrated both by excavated remains and by standing buildings. In northern Essex, cloth production was concentrated on smaller towns during the later 14th and 15th centuries (Oldland, 2018, p. 127). Although no weavers are listed in the 14th century poll tax, attempts to establish a guild of clothiers in 1583 suggests that the industry was sufficiently developed by that point (Essex County Council, 1999b, p. 4). Therefore, this growth may relate to a period in which the cutlery and weaving industries co-existed, with this area persisting as the cutlery industry waned.

The historical circumstances of each town contributed to specific developmental trajectories. At Maldon, wealth was sustained through migration and economic decline can be related to the growth of the cloth industry further north in Essex coupled with the silting of the harbour and the growth of the port of Harwich. At Thaxted the decline of the cutlery industry clearly had an impact on the economy, although development around Newbiggen Street, stimulated in part by the wealth of the regional cloth industry, led to a distinctive pattern of regeneration away from the earlier core. At Huntingdon economic decline was likely driven by falling traffic, especially after the collapse of the St Ives fair in the early 14th century. These changes are all specifically local iterations of broader economic patterns, which demonstrate how we should continue to develop approaches which do not homogenise medieval economic development through generalising models, but which seek to understand it as constituted of localised sets of situated material practices which come to be materialised through urban landscapes (Jervis, 2021; 2023).

Whilst both Maldon and Huntingdon can be shown to, some extent, to contract to the earlier core, the character of both places was quite different. At Maldon, occupation sequences attest to relatively rapid redevelopment of street frontages after fire episodes, whereas in Huntingdon excavations within the centre of the town demonstrate a clear decrease in the intensity of activity as reflected in archaeological features such as pits. What the evidence from Maldon in particular makes clear, however, is that lower intensity occupation need not indicate a decline in urban character but, rather, a change in that character, with increasing use of urban space for activities for horticulture and grazing; in the 16th century court records indicate that animals occasionally wandered Maldon's streets (Petchey, 1991, p. 87). Petchey (1991) argues that the leasing of agricultural land around Maldon restricted its potential for geographical expansion but, as argued by Dimmock (2014) leasing changed the relationship between townspeople and the land. At Thaxted in 1393 the burgage tenants are occasionally referred to as holding a garden and small 'purpresture' holdings taken from field edges (Newton, 1960, pp. 26-27). Open ground at Huntingdon too would have likely been under cultivation of some form, and substantial land management for agrarian purposes is seen at Chequer Court. Documentary evidence from the adjacent town of Godmanchester indicates that the majority of the townspeople held agricultural land (Raftis, 1982, p. 99). Raftis (1982, p. 142) likens the messuage complexes documented here as resembling the *curia* of a rural lord rather than a villagers' tenement, with plots taken up with multiple buildings, some fulfilling specialist functions, with land used for horticulture and the pasturing of animals.

A preoccupation with urban decay draws our attention towards the apparent loss of what we perceive as definitively urban characteristics, but attending to the evidence for land use emphasises the importance of agriculture and horticulture to small town households, with changes in land use perhaps relating less to a loss of urbanity towards a renewed emphasis on food production within the urban landscape, facilitated by a lessening of pressure on space which had previously pushed such activity to the periphery. Similar evidence for agrarian and horticultural production within urban limits in the later medieval period can be seen both in small towns such as Seaford (East Sussex) (Gardiner, 1995) but also larger places such as Winchester (Keene, 2022, pp.

62-66). Within a time of economic uncertainty, we can, perhaps, perceive of urban communities taking greater control over food production, reducing their reliance on the market, with this anxiety, as well as the ability of people such as butchers to accumulate landholdings in an increasingly capitalistic manner, materialised in the urban landscape.

Drawing together the evidence from excavations and standing buildings, within their historical context, goes some way to revealing the complexities of understanding urban regeneration in this period. Whilst building evidence attests to speculative development and economic confidence, it also indicates a sustained pressure on urban space, even as plots are reported as abandoned and display limited archaeological evidence for intensive occupation of a stereotypically 'urban' character. In contrast, excavation data demonstrates how whilst development could be patchy, the changes of the 14th century unsettled uses and perceptions of urban space, creating pressure which was not only the outcome of population growth but also the result of changes in land use which became entrenched in urban space. It is for this reason that it is productive to think through this period not in terms of decay and decline, but of transformation, both of urban spaces and of urban society.

Open Data Statement

The datasets underpinning this paper are available as supplementary materials. This comprises three datasets summarising excavations within the towns and the evidence for medieval occupation. Data on standing buildings is freely available from the National Heritage List for England <https://historicengland.org.uk/listing/the-list/>

Acknowledgements

This work was undertaken as a part of the project ENDURE: Urban Life in a Time of Crisis. Enduring Urbanism in Later Medieval England, selected by the European Research Council and funded by UKRI under grant agreement EP/X023850/2. We are grateful to Maria Medlycott (Essex County Council) and Ruth Beckley (Cambridgeshire County Council) for assistance in the provision of HER data and to other members of the ENDURE team; Joe Chick, Gwen Maurer and Richard Madgwick for their insights.

References

- Andrews, D. (1989). A late medieval cutlery manufacturing site at Weaverhead Lane, Thaxted. *Essex Archaeology & History* 20, 110-119.
- Andrews, D. & Stenning, D. (1989). Wealden houses and urban topography at the lower end of Maldon High Street. *Essex Archaeology & History* 20, 103-108.
- Andrews D. & Stenning, D. (1996). More Maldon Wealdens. The origins and development of the King's Head, Maldon High Street. *Essex Archaeology & History* 27, 214-225.
- Ashworth, H. (2002). *Land at Weaverhead Lane, Thaxted*. Heritage Network.
- Astill, G. (1985). Archaeology and the smaller medieval town. *Urban History* 12, 46-53.
- Astill, G. (2000). Archaeology and the late-medieval urban decline. In T. Slater (ed.) *Towns in Decline, AD 100-1600* (pp. 214-234). Ashgate.
- Bassett, S. (1972). *Final Interim Report on the Archaeological Investigation of the Site of 62-64 High Street, Maldon*. Essex County Council.

- Beresford, M. (1967). *New Towns of the Middle Ages*. Lutterworth Press.
- Bridbury, A. (1981). English provincial towns in the later Middle Ages. *Economic History Review* 34(1), 10-24.
- Briscoe, J., Martin, B., Martin, D. & Whittick, C. (2019). *How Houses Rvolved: Houses in the Eastern High Weald of Sussex 1350-1750*. SpoilHeap Publications
- Britnell, R. (1987). The Black Death in English towns. *Urban History* 21(2), 195-210.
- Brooks, H. & Wightman, A. (2010). *Archaeological Evaluation and Excavation at 143-147 High Street, Maldon, Essex*. Colchester Archaeological Trust.
- Cambridge County Council. (2015). *The Historic Towns of Cambridgeshire Extensive Urban Survey: Huntingdon*. <https://doi.org/10.5284/1045792>
- Campbell, B. (2016). *The Great Transition. Climate, Disease and Society in the Late Medieval World*. Cambridge University Press.
- Carew, T. (2007). *Quest Motors, 127-129 High Street, Maldon, Essex. An Archaeological Archive Report*. AOC Archaeology. <https://doi.org/10.5284/1003815>
- Carus-Wilson, E.M. (1965). The first half-century of the borough of Stratford-upon-Avon. *Economic History Review* 18(1), 46-63.
- Carvey, C. (2019). *Archaeological Excavation. Land at Mill End, Thaxted, Essex. Post-Excavation Assessment*. Archaeology South-East. <https://doi.org/10.5284/1104511>
- Clarke, R. (2004). *Bronze Age, Roman, Late Saxon, Medieval and Post-Medieval Remains in Huntingdon Town Centre, Cambridgeshire: An Archaeological Evaluation*. Cambridgeshire County Council.
- Clarke, R. (2005). *Medieval and Post-Medieval Remains at 11-12 High Street, Huntingdon*. Cambridgeshire County Council.
- Clarke, R. (2006). *Prehistoric Activity, Medieval Occupation and Post-Medieval Industry to the Rear of Walden House, Huntingdon, Cambridgeshire*. Cambridgeshire County Council. <https://doi.org/10.5284/1002625>
- Clarke, R. (2009). *Late Saxon to Post-Medieval Occupation and Industry to the Rear of Gazeley House and Lawrence Court (Huntingdon Town Centre), Huntingdon, Cambridgeshire*. Oxford Archaeology East.
- Clarke, R. (2011). *Undated Ditches, Medieval Deposits and Structural Evidence and Post-Medieval Layers at Chequers Court Car Park, Huntingdon*. Oxford Archaeology East.
- Conzen, M.G.R. (1960). *Alnwick, Northumberland: A Study in Town-plan Analysis*. Institute of British Geographers.
- Dimmock, S. (2014). *The Origins of Capitalism in England 1400-1600*. Brill
- Dobson, R. (1977). Urban decline in late medieval England. *Transactions of the Royal Historical Society* 27, 1-22.
- Dyer, A. (1991). *Decline and Growth in English Towns 1400-1640*. Cambridge University Press.
- Dyer, C. (2002). Small places with large consequences: The importance of small towns in England, 1000-1540. *Historical Research* 75(187), 1-24.
- Dyer, C. (2003). The archaeology of medieval small towns. *Medieval Archaeology* 47, 85-114.
- Dyer, C. (2015). Medieval small towns and the late medieval crisis. In J. Drendel (ed.) *Crisis in the Later Middle Ages. Beyond the Postan-Duby Paradigm* (pp. 35-53). Brepols.
- Ennis, T. (2009). *Former Croxley Works Site, Church Street, Maldon, Essex. Archaeological Evaluation and Excavation*. Essex County Council. <https://doi.org/10.5284/1003825>
- Ennis, T. (2015). Late Saxon and medieval occupation at the former Bus Station, 148-152 High Street, Maldon. *Excavations 1999. Essex Archaeology & History* 5, 289-311.
- Ennis, T. (2010). *67 Newbiggen Street, Thaxted, Essex*. Essex County Council. <https://doi.org/10.5284/1009373>

- Ennis, T. (2016). *Archaeological Excavation. The Rose and Crown, 109 High Street, Maldon, Essex. Post-Excavation Assessment and Updated Project Design Report*. Archaeology South-East. <https://doi.org/10.5284/1104481>
- Essex County Council. 1999a. *Historic Towns in Essex: Maldon. Historic Towns Assessment Report*. Essex County Council. <https://doi.org/10.5284/1000097>
- Essex County Council. 1999b. *Historic Towns in Essex: Maldon. Historic Towns Assessment Report*. Essex County Council. <https://doi.org/10.5284/1000097>
- Field, N. (1973). The Leaze, Wimborne. An excavation in a deserted quarter of the town. *Proceedings of the Dorset Natural History and Archaeological Society* 94, 49-62.
- Freke, D. (1999). *St Germain Street, Sainsbury's Development, Huntingdon. Archaeological Assessment Report*. Planning, Transport, and Environment.
- Forshaw, A. (2017). *Archaeological evaluation report. Land off Mill End, Thaxted, Essex*. Archaeology South East. <https://doi.org/10.5284/1078468>
- Gardiner, M. (1995). Aspects of the history and archaeology of medieval Seaford. *Sussex Archaeological Collections* 133, 189-212.
- Germany, M. & Wade, A. (1998). Archaeological evidence for the late medieval cutlery industry: Excavation at the rear of 34 Town Street, Thaxted. *Essex Archaeology & History* 29, 286-293.
- Greef, A. (2019). *Late Saxon to Medieval Remains at Ferrars Road, Huntingdon, Cambridgeshire. Archaeological Excavation Report*. Oxford Archaeology East.
- Goddard, S. (1993). *Weaverhead Lane, Thaxted. Archaeological Watching Brief*. Essex County Council.
- Goddard, R. (2011). Small boroughs and the manorial economy: Enterprise zones or urban failures? *Past & Present* 210, 3-31.
- Harding, C. (2019). Late Saxon/early medieval buildings and the Chequers public house, 60 High Street, Maldon: Excavation, 1987. *Essex Archaeology & History* 10, 37-72.
- Jervis, B. (2017). Decline or transformation? Archaeology and the late medieval 'urban decline' in southern England. *Archaeological Journal* 174, 211-243.
- Jervis, B. (2023). Urbanity, decline and regeneration in later medieval England: Towards a posthuman household microhistory. *Open Archaeology* 2024 10: 20220355 <https://doi.org/10.1515/opar-2022-0355>
- Jervis, B. (2024). Repetition, persistence and generality: Problematising the endurance of medieval urbanity. *World Archaeology* 55(2), 125-138.
- Jervis, B. (2025). Beyond urban hinterlands. Political ecology, urban metabolism and extended urbanization in medieval England. *Cambridge Archaeological Journal* 35(1), 127-148.
- Johnson, M. (1993). *Housing Culture. Traditional Architecture in an English Landscape*. UCL Press.
- Keene, D. (2022). Agriculture and the use of plants in medieval Winchester: The documentary evidence. In M. Biddle, J. Renfrew & P. Ottaway (eds.) *Environment and Agriculture of Early Winchester* (pp. 57-71). Archaeopress.
- Lilley, K. (2000a). Decline or decay? Urban landscapes in late-medieval England. In T. Slater (ed.) *Towns in Decline, AD100-1600* (pp. 235-265). Ashgate.
- Lilley, K. (2000b). Mapping the medieval city: Plan analysis and urban history. *Urban History* 27(1), 5-30.
- Lilley, K. (2001). Urban planning and the design of towns in the Middle Ages: The Earls of Devon and their 'new towns'. *Planning Perspectives* 16, 1-24.
- Lilley K. (2015). Urban planning after the Black Death: Townscape transformation in later medieval England (1350-1530). *Urban History* 42(1), 22-42.
- Martin, D. and Martin, B. (2004). *New Winchelsea Sussex, A Medieval Port Town*, University College London.

- Medlycott, M. (1993). *The Old Gasworks Site, High Street, Maldon. Archaeological Watching Brief*. Essex County Council.
- Medlycott, M. (1996). Medieval and post-medieval remains from Thaxted Excavations at the rear of 23 Town Street 1992. *Essex Archaeology & History* 27, 331-336.
- National Heritage List for England (NHLE) entry 1256860: 90, 92 and 94, High Street, Maldon. <https://historicengland.org.uk/listing/the-list/list-entry/1256860?section=official-list-entry>
- Newton, K.C. (1960). *Thaxted in the Fourteenth Century. An Account of the Manor and Borough, with Translated Texts*. Essex County Council.
- Pearson, S. (2009). Medieval houses in English towns: Form and location. *Vernacular Architecture*, 40, 1-22.
- Petchey, W.J. (1991). *A Prospect of Maldon 1500-1689*. Essex County Council.
- Pooley, L. (2016). Archaeological Evaluation and Excavation on Land to the North of Orange Street, Thaxted, Essex. Colchester Archaeological Trust.
- Raftis, J.A. (1982). *A Small Town in Late Medieval England; Godmanchester 1278-1400*. Pontifical Institute of Medieval Studies.
- Roberts, E. (2007). W. G. Hoskins' 'Great Rebuilding' and dendrochronology in Hampshire. *Vernacular Architecture* 38, 15-18.
- Roy, M. (2004). Late medieval and post-medieval remains at the former St John's ambulance shop, Park Street, Thaxted. *Essex Archaeology and History* 35, 230-233.
- Slater, T. (2005). Plan characteristics of small boroughs and market settlements: Evidence from the Midlands. In K. Giles and C. Dyer (eds.) *Town and Country in the Middle Ages* (pp. 23-41). Maney.
- Thatcher, C. (2013). *Medieval Drainage and Cultivation at Chequers Court, Huntingdon*. Oxford Archaeology East. <https://doi.org/10.5284/1035871>
- Thatcher, C. (2019). *Roman to Medieval Remains at Edison Bell Way, Huntingdon, Cambridgeshire*. Oxford Archaeology East.
- Williamson, I. (2005). *151 High Street, Huntingdon, Cambridgeshire. An Archaeological Evaluation*. Archaeological Solutions Ltd.

Simone Sani^{*/§}, Niccolò Mazzucco^{*}, Davide Mengoli^{**}, Elisabetta Starnini^{*}

^{*} Dipartimento di Civiltà e Forme del Sapere, Università di Pisa.

^{**} Istituto Italiano di Paleontologia Umana (IIPU) / Lares s.r.l.

[§] Corresponding author (simone.sani@cfs.unipi.it).

THE OBSIDIAN MANAGEMENT IN THE CENTRAL MEDITERRANEAN: A CASE STUDY FROM FORNACE CAPPUCCINI (NORTHERN ITALY, EARLY NEOLITHIC)

Abstract: Obsidian played a central role in the socioeconomic changes that took place in the central Mediterranean during the early stages of Neolithization, marked by an increased circulation of exogenous materials and the rise of specializations that often led to unequal access to distant resources. Through the case study of Fornace Cappuccini (Faenza, RA, Early Neolithic), this work investigates the variability in obsidian management and exchange practices within the interaction networks of early farmers. Technological data suggest that obsidian was at

least partially knapped locally, despite the site's location at the northern margins of raw material distribution. Functional analysis of macroscopic use-wear traces indicates that part of the complex was used for working soft materials. These results suggest that this exogenous raw material had distinct management and use, partially overlapping with flint industries.

Keywords: Obsidian, stone tools, neolithic exchange, technological analysis, functional analysis.

1. Introduction

Obsidian appears in archaeological contexts of the central Mediterranean beginning in the late 7th millennium BC, marking one of the most significant innovations among Neolithic populations. It quickly became one of the most widely circulating materials, reaching sites hundreds of kilometres far from its outcrops (Tykot, 2017). Given that obsidian deposits in central Mediterranean are exclusively located on the islands of Lipari, Palmarola, Sardinia (Monte Arci), and Pantelleria, the circulation of this volcanic glass is closely linked to navigation practices, which seem to have intensified during the Neolithic, facilitating long-distance interactions (Farr, 2006).

Obsidian assemblages from sites of the Italian peninsula have been primarily studied with a typological approach. Only a few sites provide sufficiently detailed technological data, and even fewer have been examined from a functional perspective (Ammerman et

al., 1988; Iovino, 1997, 2000, 2001; Iovino & Martinelli, 2008; Lemorini, 2007; Setzer, 2004; Starnini & Voytek, 1997; Tykot et al., 2006). Yet, these aspects are crucial for understanding the patterns of circulation and management of this exogenous material.

The integration of chronological, technological, use-wear and provenance data remains partially incomplete. For these reasons, the circulation of obsidian in the central Mediterranean continue to represent one of the most challenging topics in the study of early agricultural societies.

2. Materials and methods

2.1 The archaeological site of Fornace Cappuccini

Fornace Cappuccini is located in Emilia-Romagna (northern Italy) in the city of Faenza (RA), which lies approximately 25 km from the Adriatic Sea at the mouth of the Lamone River Valley and close to the Senio River Valley. This location serves as a transition zone between the Tuscan-Romagna Apennines and the southeastern Po Valley (fig. 1, a, b).

Archaeological investigations began in 1978 as part of a rescue archaeology project (fig. 1, c). An approximately 680-meter-long circular ditch was uncovered in the eastern sector, which may have been associated with an embankment (Antoniazzi et al., 1990). The deeper fill layers of the ditch yielded fragments of Impressed Ware, suggesting that the construction of the ditch can be attributed to the site's initial occupation (Antoniazzi et al., 1987, 1990; Bermond Montanari & Massi Pasi, 1998). Negative features were found both inside and outside the perimeter of the ditch, mainly concentrated in the western sector. The structures are primarily small, circular pits, but some complex-shaped features have also been detected. For the majority, a residential function seems unlikely, except perhaps for structure 30/83, which has been preliminarily interpreted as a combustion feature, although its interpretation remains controversial (Mengoli, 2011). Most negative structures may have ultimately served as waste or garbage pits after initially being used for productive activities, as proposed for some sites in the Po Valley (Biagi et al., 2020; Pearce, 2008; Starnini et al., 2018). Due to damage of the upper layers, which may have contained occupational floors, and the limitations of the excavation's documentation, a more complex interpretation of the site's structures is not possible. Concerning their chronology, eighteen out of twenty-three structures can be confidently attributed to the Impressed Ware phase, based on the pottery assemblage recovered (Mengoli, 2011). Later structures, attributed to the Eneolithic phases, have been excluded from this study.

Three radiocarbon dates have been obtained from features associated with Impressed Ware pottery:

- Structure 1 (Bln-3372): 6320 ± 60 uncal. BP (charcoal)¹;
- US 443 (R-2314): 6280 ± 80 uncal. BP (unknown sample)²;
- US 435/E (R-2313): 6100 ± 170 uncal. BP (unknown sample)³.

¹ Antoniazzi et al., 1990; Bagolini & Biagi, 1987.

² Bermond Montanari, 2000.

³ Bermond Montanari, 2000.

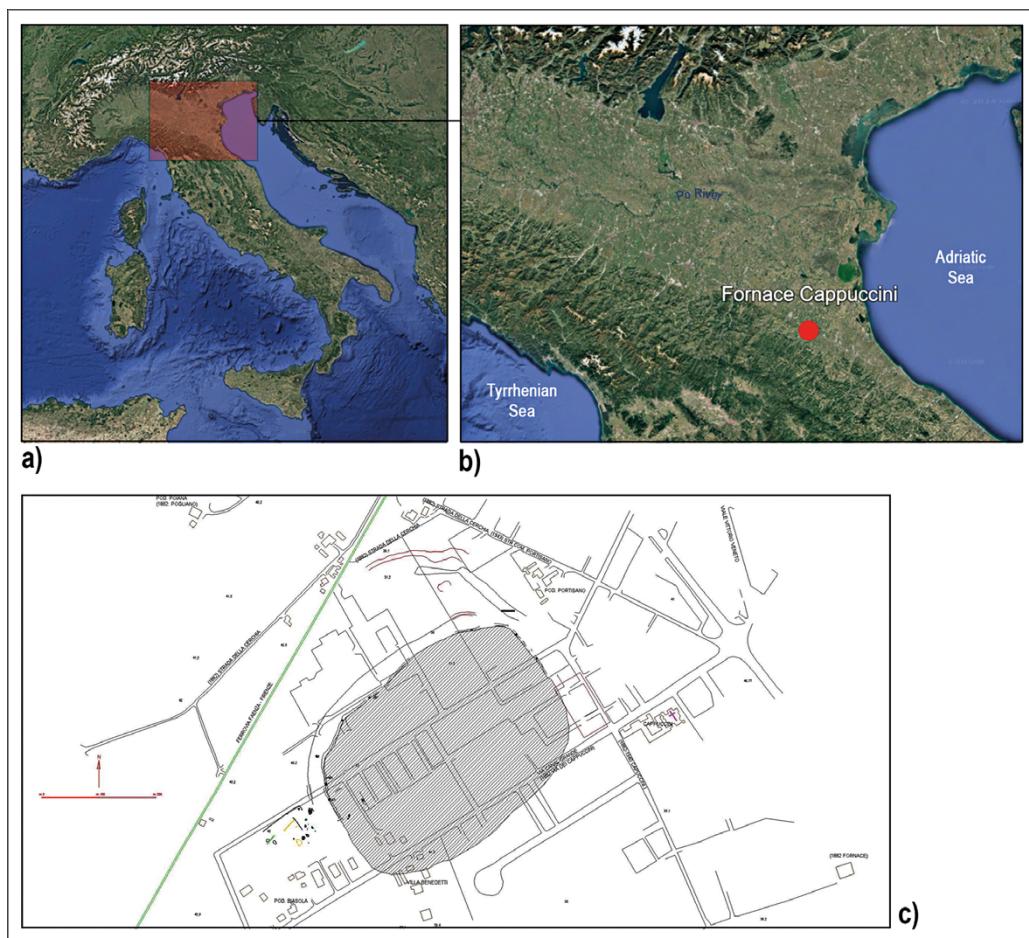


fig. 1. Location of the site and archaeological survey projections. a) East-central Po Plain (in red) within the central Mediterranean context; b) Site location; c) Area included in the preventive archaeology project. Grey hatching indicates the positioning of excavations and survey projections.

Using the OxCal v.4.4 calibration program (Bronk Ramsey & Lee, 2013) with the IntCal20 calibration curve (Reimer et al., 2020), the following calibrated BC dates (2σ) were obtained:

- Bln-3372: 5472-5079 cal. BC
- R-2314: 5471-5031 cal. BC
- R-2313: 5469-4613 cal. BC

The calibrated dates indicate that the settlement was primarily occupied during the second half of the 6th millennium BC, which is consistent with the few ^{14}C dates available from the area (Bagolini & Biagi, 1990) and the material culture of the northern Adriatic Impressed Ware sites (Bagolini & Ghirotti, 1980; Bagolini & von Eles, 1978; Bagolini et al., 1991). Although the available ^{14}C measurements are limited

and based on unidentified wood charcoal samples (Bermond Montanari, 2000), the general chronological attribution of the site appears accurate and coherent with the available chrono-cultural framework for the Upper Adriatic region.

Recovered materials are abundant and include lithic and ceramic industries, concentrations of charcoal, and daub fragments, while polished stone objects were only sporadically present, and bone industry was absent (Antoniazzi et al., 1987; Bermond Montanari et al., 1991).

The entire lithic assemblage consists of 7608 artefacts (Mazzucco et al., 2018, **tab. 1**). Lithic production primarily utilised *Scaglia Rossa*, sourced from areas about 80-100 km from the site. Local flint is also present, found as siliceous pebbles in the *Sabbie Gialle* deposits. Exceptional exogenous finds include Lessinian flint, Apennine flint and jasper and ftanite from Liguria (Antoniazzi et al., 1987, p. 559; Bagolini & Biagi, 1987, 1987b; Bermond Montanari et al., 1991; Mengoli, 2011).

The initial block shaping likely did not occur on-site. The products were mainly extracted from unidirectional prismatic cores with single debitage surfaces, which were abandoned when exhausted. The production sequences are primarily oriented towards laminar production, utilizing both pressure flaking and indirect percussion techniques. A secondary, less organised sequence for producing flakes has also been identified (Mengoli, 2011). Retouched tools are mainly blades, with laterally retouched blades and notched blades prevailing, along with burins, geometrics, and truncations. The micro-burin technique is also widely attested (Mengoli, 2011). Thirty-eight sickle blades were identified, some of which showed traces of adhesive substances (Finocchiario, 2023; Mazzucco et al., 2018, 2020).

Obsidian, found in exceptional quantities for such a northern site, will be discussed later.

2.2 Analysis methodology

The obsidian assemblage, which had already been preliminarily studied as part of the chipped stone industry of Fornace Cappuccini (Mengoli, 2011), was subject to a revision and a dedicated study, separate from the analysis of artifacts made from other raw materials. The materials were initially categorised by technology and typometry to identify recurring patterns and possible refittings. A dataset (FC_obs_Technology) was created, and the following analysis methodology is outlined:

- **Artifact identification.** The site name, the identifying number and layer of the piece are recorded.
- **Raw material description.** Preliminary classification of the lithic raw materials has been carried out relying on macroscopic aspects. Each piece is analysed using a stereoscopic microscope (OPTIKA SZ-T, 5x-40x), by observing the properties and characteristics of the surfaces and matrix. Translucency is defined, and the matrix is qualitatively described by assessing its uniformity and discontinuities, as well as the presence and distribution of inclusions (phenocrysts) and fractures potentially originating from them. The surfaces are examined for characteristics such as sheen and reflection. Based on these observations, the raw material is classified into a variant.

- **Technological characterization.** The technological analysis follows the methodologies proposed by Inizian et al. (1999) and Tixier (1984), aiming to recognise the different production sequences (Leroi Gourhan, 1964) and the knapping management. For each element, the degree of integrity and the type of product is recorded, which is assigned, when possible, to a corresponding flaking phase. The three largest dimensions of each element were measured, except for debris or small fragments under 7 mm, which are not diagnostically significant. Special attention was given to the laminar elements and their maximum dimensions, which were considered only for intact pieces, where dimensional ratios may be indicative of the different flaking modules. For dimensional analysis of blades, a “k-means” clustering method was applied using *RStudio* (packages: *ggplot2* and *dplyr*) to identify the main modules among the intact pieces based on thickness and width. From a morphological point of view, the shapes, sections, profiles, butts, bulbs, and overhangs were described as diagnostic characteristics of preparation, flaking methods, applied force, and type of hammer. If present, cortex morphology and its extension was recorded, with the aim of determining the original nature of the raw material exploited.
- **Alterations description.** This refers to natural alterations caused by post-depositional processes, such as patina formation or by potential anthropogenic factors, like contact with fire.
- **Typological description.** Retouched elements are listed and briefly described according to Laplace’s typological classification method (1964).
- **Notes.** Observations regarding all the previously analysed aspects, any recurring patterns, refitting possibilities, and detailed technological descriptions are noted.

The entire assemblage was subjected to an initial analysis focusing on macroscopic use-wear traces, representing the first stage of a more in-depth study that will be carried out on the Fornace Cappuccini assemblage. This study will include high-power (reflected light microscopy) and quantitative approaches (confocal microscopy).

We aim to provide a preliminary classification of the material according to macro-wear patterns. Specifically, we aim to: 1) identify possibly used areas; 2) characterise the macro-damage; 3) propose a functional classification of the materials based on kinematics (transversal / longitudinal / rotational / percussive motions) and the hardness of worked materials (soft / medium-abrasive / hard materials).

All the items were examined under a stereoscopic microscope (OPTIKA SZ-T, 5x-40x), with magnifications ranging from 10x to 40x. Areas that retained macroscopic use-wear traces were photographed using a microscope adapter and the OPTIKA Lite View software. A Dino Lite Edge 3.0 digital microscope, equipped with Dino Capture 2.0 software, was also used to record some of the use-wear traces. Observations were recorded in a dedicated dataset (FC_obs_Traceology) for the identified use-wear traces, following the methodology outlined below.

- **Preservation.** Post-depositional alterations on the surfaces were identified, which may affect the accurate interpretation of use-wear traces (Clemente Conte et al., 2015, pp. 73-75; Hurcombe, 1992a, pp. 71-78).

- Identification and description of traces from a macroscopic perspective. The number of areas potentially affected by use was recorded, along with their position relative to the face and edges. The type, pattern, distribution, localization, and direction of the traces were described at a macroscopic level using a low-power approach (Odell, 1987, 2001; Odell & Odell-Vereecken, 1980; Tringham et al., 1974; see Grace, 1996, for a review) and following methodologies published in previous works on obsidian assemblages (Brito-Abrante & Rodríguez-Rodríguez, 2024; Clemente-Conte et al., 2015; Gibaja & Mazzucco, 2023; Hurcombe, 1992a, 1992b; Kononenko, 2011; Mengoli & Mazzucco, 2018; Setzer, 2004, 2012; Walton, 2019).
- The presence of edge rounding was noted, and its intensity classified into general categories (low / high) based on intra-tool comparisons. Striations were recorded, along with their direction relative to the edges, distribution type, and groove depth. Finally, any association between traces and edge retouching, as well as the presence of gloss, was also registered.
- Reliability of the wear patterns. Objects were classified based on the readability of the use-wear traces into two categories (possibly used / used).
- Residues. Traces of residues on the surfaces, potentially organic substances or adhesives, were described in terms of colour and distribution. If sufficiently abundant, they were sampled using a surgical scalpel and sterile gloves and prepared for gas chromatography analysis.
- Kinetic interpretation and hardness of the worked material. Based on the observed traces, possible actions performed by the artefact edges have been inferred, as well as the hardness estimation of the worked materials.

3. Results

3.1 Raw material

Qualitative observations on the raw material enabled a preliminary macroscopic classification into three main obsidian variants:

- Group 1. Characterised by a mostly uniform and semi-translucent matrix, with some non-translucent elements. The surfaces are glossy, often with patches of discontinuities. This is the largest group, comprising 169 items, of which 47 display phenocrystals.
- Group 2. Characterised by a generally less uniform and semi-translucent matrix, with more non-translucent elements than Group 1 and more items with phenocrystals (43). The surfaces are frequently opaquer, often showing parallel bands, sometimes with yellowish tones. This is the intermediate group in terms of quantity, comprising 110 items.
- Group 3. Characterised by a uniform matrix that is completely or nearly translucent. Occasionally, bubble-like discontinuities appear in the matrix, with a dotted or longitudinal distribution. Inclusions are rarer, only 9 items display phenocrystal and impurities. This is the smallest group, with 70 artifacts.

Analysis of the assemblage revealed a clear link between translucency and the presence or absence of patina. Fresh breaks in some artifacts show glossy surfaces hidden beneath post-depositional alteration patinas that had rendered them opaque. Thus, the proposed classification is inevitably affected by alterations produced by post-depositional processes. Additionally, it should be noted that the translucency of the surfaces is partly influenced by the thickness of the artifacts. Inclusions have a significant impact on the quality of the raw material; in 25 pieces, fractures, reflections, surface irregularities, or notch formations were noted due to the presence of phenocrystals within the glassy matrix.

Provenance analyses, using the fission track method on a limited sample of artifacts (18 out of 349), identified the islands of Palmarola (10 samples) and Lipari (8 samples) as sources of supply (Bigazzi & Radi, 2003). New non-destructive provenance studies are currently underway on the entire collection using pXRF at the Laboratory of Archaeometry and Diagnostics of the University of Pisa.

3.2 Technological and morphometric data

The obsidian assemblage consists of 349 items. Artefacts are not evenly distributed across the site, forming three main concentration clusters (**fig. 2**). Furthermore, Structure 1 stands out, having yielded 118 items, approximately one-third of the entire assemblage (Antoniazzi et al., 1987, p. 559). The degree of fragmentation is high, with only 79 pieces (approximately 23%) remaining intact. A single conjoint has been found, consisting of a cortical bladelet from two different structures (31/40 and 30/83).

One core was recovered, whose characteristics will be described later. Among the products, blades are predominant, making up almost half of the entire complex (48%).

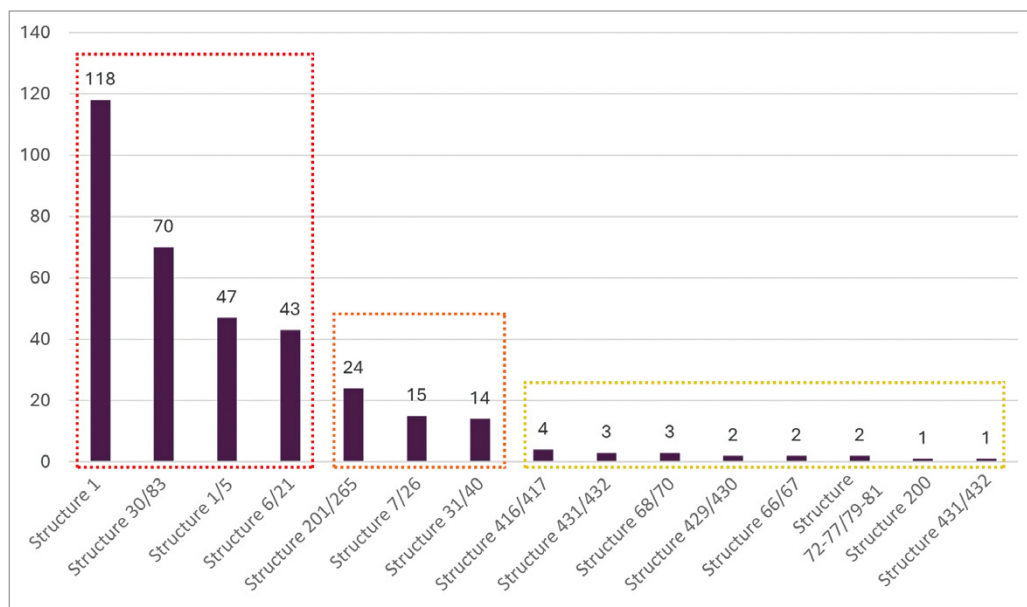


fig. 2. Intra-site distribution of obsidian. X-axis: structures; Y-axis: quantities. The dataset is grouped into three clusters based on quantity: red (higher quantities), orange (intermediate quantities), and yellow (lower quantities).

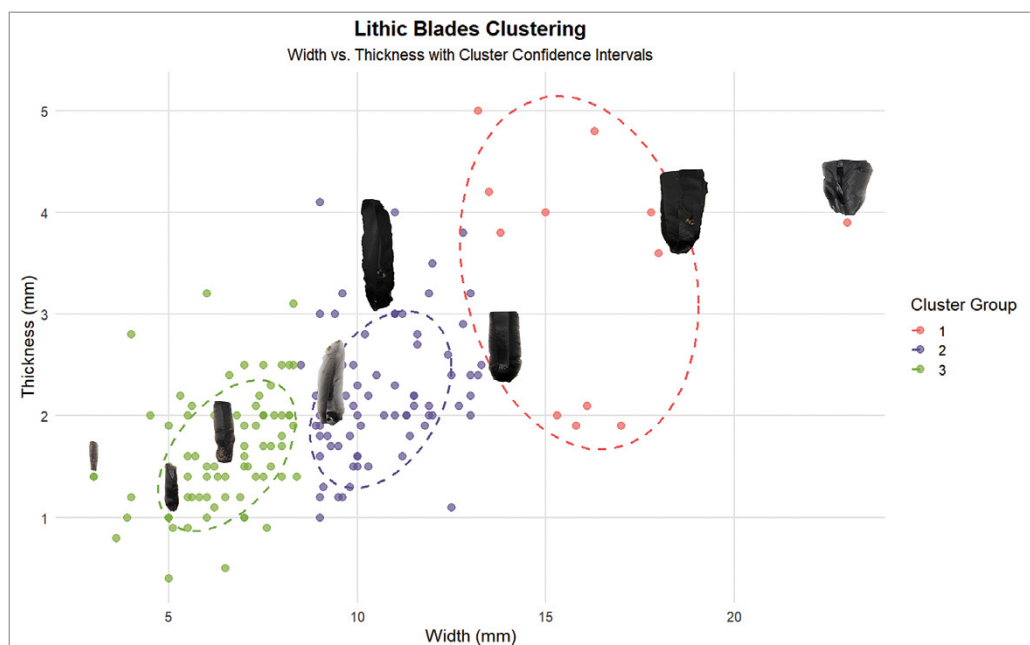


fig. 3. Scatter plot based on width (x-axis) and thickness (y-axis) of blades. Cluster 1 is shown in red, cluster 2 in blue, and cluster 3 in green. Archaeological examples are plotted on the Cartesian plane.

Maximum blade width and thickness are the main parameters employed to identify blade-knapping modules. Plotting the measures, three main clusters, corresponding to three potential different blade-knapping modules, were identified (fig. 3). However, only one knapping module was significantly distinct enough to be clearly separated from the others.

- Cluster 1 includes 12 blades with maximum widths between 13.2 and 23 mm and maximum thicknesses between 1.9 and 5 mm.
- Cluster 2 consists of a larger number of blades and bladelets (74), with maximum widths ranging from 8.5 to 13.3 mm and thicknesses between 1 and 4.1 mm.
- Cluster 3, also large, is composed of 76 bladelets and micro-bladelets with maximum widths from 3 to 8.4 mm and thicknesses from 0.4 to 3.2 mm.

The complex also contains a substantial number of flakes (32%), including a notable number of laminar flakes and debitage flakes. Among the core rejuvenation elements, platform rejuvenation flakes are the most common, along with some overhang rejuvenations and a partial tablette, suggesting the management of percussion platforms. Flakes rarely show preparation on the percussion platform; smooth butts are more common.

The presence of debris and various phases of the production sequence suggests that, at least partially, obsidian knapping took place on-site. However, only 23 pieces of production waste were found, suggesting the reduction of prepared cores. Obsidian likely reached the site in form of partially decorticated blocks, as indicated by the low number of cortical elements, which make up just over 13% of the total. The

cortex characteristics, mostly smooth and lacking roughness, indicate a sourcing of the blocks from secondary deposits.

Artifacts were mainly produced following three operational sequences aimed at creating both blade and flake supports:

Operational sequence 1 (CO1). It represents an incomplete production sequence. Only finished products are represented, consisting of blades extracted from larger modules than those most common in the complex, corresponding to Cluster 1 (fig. 4, a). No preparation or core rejuvenation elements, or production waste, were found. The fragmentary state of these products prevents a definitive determination of the minimum core length; however, blades approximately 10 cm long were likely produced. These blades typically show trapezoidal cross-sections, convex profiles, and faceted butts, when conserved. This operational sequence therefore required an accurate preparation of the striking platforms. Considering the absence of knapping management and waste elements, blades from larger CO1 cores were likely introduced into the site as finished products. Notably, there was some variability in the quality of raw materials used for these blanks, with some pieces being inclusion-free and highly translucent, while others were opaque and rich in phenocrysts.

Operational sequence 2 (CO2). Almost the entire operational sequence is represented (fig. 4, b). Bladelets and microbladelets with variable morphology were produced (fig. 4, b, 1). The presence of many complete bladelets, some with similar morphologies, allows a more precise estimation of original core lengths. Products exhibit similar widths, mainly around 10 mm, and at least 5 complete bladelets, quite similar to each other, suggest extraction from cores approximately 5 cm in length. These bladelets show knapping angles close to 90°, trapezoidal sections, and curved distal ends. Blades are mostly fragmented, with proximal fragments predominating, and several elements show fractures in the mesial areas, including at least five pieces with bending fractures caused by notches or retouching. In some cases, the presence of these elements, along with the high frequency of fractures on similar sections of typometrically comparable pieces, suggest breaking intentionality. This sequence also includes several proxies of on-site knapping, such as debitage flakes (fig. 4, b, 2) and rare core preparation elements. Overhang rejuvenations, rejuvenations flakes, and partial core tablettes indicate stages of knapping management (fig. 4, b, 3). With nearly all stages of the production process represented, numerous debris elements can likely be linked to this operational sequence.

A single core is present: an intact, sub-pyramidal *tournant* core (fig. 4, b, 5), from which microbladelets were extracted. These microbladelets are morphometrically comparable to some found in the assemblage. This core was likely abandoned due to exhaustion and hinged extractions, with one occurrence related to the presence of a large inclusion. Detachments are unidirectional, with the last two extractions made after platform rejuvenation. Two artifacts are identifiable as rejuvenation byproducts of pyramidal or sub-pyramidal core-tips. They show unidirectional detachments (fig. 4, b, 4), with one clearly displaying microblade morphometry, probably produced by pressure flaking. Thus, cores were likely rejuvenated and used until exhausted.

Operational sequence 3 (CO3). Flakes of varying sizes (fig. 4, c) are detached using multidirectional exploitation patterns, indicating a more unstructured knapping



fig. 4. Technological composition of the Fornace Cappuccini complex. a) Technological composition of CO1; b) Technological composition of CO2. 1. Blades; 2. Débitage flakes; 3. Platform rejuvenation flakes; 4. Rejuvenations of sub-pyramidal core bases; 5. Core. c) Technological composition of CO3. 1. Fully cortical flake; 2. Flakes; Flake extracted using bipolar on anvil technique. Scale: 3 cm.

management. The presence of direct percussion is evident, given the morphology of the impact points, the widespread occurrence of prominent bulbs, and the discontinuous ventral surfaces on some specimens. Some artifacts also appear to have been produced by bipolar-on-anvil technique (fig. 4, c, 3), as showed by scars on the distal and proximal edges. This operational sequence may be linked to local, occasional production by non-specialised knappers.

3.3 Functional data

Although much of the assemblage shows some taphonomic alteration, it is generally well-preserved, which has made it possible to identify a significant number of artifacts suitable for more detailed analysis. Several flakes showed unmodified, sharp, and intact edges, indicating that the assemblage has not suffered from strong mechanical alterations. Moreover, strong rounding at the dorsal ridges was not detected during macroscopic observation, further confirming that the assemblage is generally well-preserved. Only a few items (2%) are characterised by strong patinas and chemical alterations, and these implements have not been considered for use-wear analysis.

As result of the analysis, a total of 87 pieces exhibited potential use-wear traces, within which a subgroup of 23 items showed more evident and diagnostic traces, primarily on blades. Unifacial use predominates, with 67 items, compared to bifacial one, represented by 20 pieces (tab. 1).

Given the frequent use of multiple edges on the same tool, a total of possibly 130 used areas were identified across 87 tools, with most of them located on the edges of bladelets, microbladelets, or laminar flakes. In contrast, none of the flake show use on more than one edge, except for a single tool (fig. 5, b, 129), which, heavily modified by retouching (A2, *sensu* Laplace, 1964), showed potential wear traces on three edges (right, left, and transverse).

	USE-WEAR						MOVEMENT			INTERPRETATION		
	Possible	Definite	Tot	Used areas	On retouch	Opposite to retouch	Transversal	Longitudinal	Mixed	Working of soft/low-resistance material	Working of hard/abrasive material	Hafting/handling
Blades/Laminar flakes	48	20	68	108	28	17	65	34	1	80	11	17
Unretouched blades	17	4	21	26	0	0	16	9	1	23	1	2
Laterally retouched blades	12	8	20	33	6	5	26	7	0	21	8	4
Backed blades	5	4	9	19	9	7	11	8	0	11	1	7
Truncations	7	0	7	10	4	0	7	3	0	9	0	1
Notched blades	5	2	7	12	4	4	10	2	0	10	1	1
Composite tools	2	2	4	8	5	1	3	5	0	6	0	2
Flakes	12	2	14	16	3	1	14	2	0	13	2	1
Unretouched flakes	5	1	6	6	0	0	5	1	0	6	0	0
Laterally retouched flakes	1	1	2	2	2	0	2	0	0	2	0	0
Rejuvenation flakes	6	0	6	8	1	1	7	1	0	5	2	1
Composite tools	0	0	0	0	0	0	0	0	0	0	0	0
Ind	3	0	3	3	1	0	3	0	0	3	0	0
Notched ind	1	0	1	1	1	0	1	0	0	1	0	0
Spalls	0	1	1	2	1	0	0	1	0	1	1	0
Waste	1	0	1	1	1	0	1	0	0	1	0	0
Total	64	23	87	130	34	18	83	36	1	98	14	18

tab. 1. Functional data on macro-wear traces: counts of “possible,” “definite,” and “total” related to product type. Additional counts correspond to all identified used areas associated with each product type.

Most of the tools showing wear are associated with retouching (53 pieces), 47 of which are blades, especially laterally retouched bladelets, backed bladelets and truncations. Retouched blades, in particular blades with lateral retouching (L, *sensu* Laplace, 1964) appear to have been preferred for use over other technological categories. Among the retouched items, two main groups can be distinguished: one exhibits abrasions and notches on the opposite edge to the retouched one, while the other shows wear traces on the retouched edge, which forms the larger group. (fig. 5, a).

Some flakes also show potential use-wear patterns like those observed on blades (fig. 5, b). These include both unifacial and bifacial abrasions and fractures, sometimes associated with retouched edges (fig. 5, b, 5085 and 129).

Transversal actions are the most frequently observed within the assemblage (tab. 1). The directionality of chippings, fractures, and striations on the analysed tools indicate extensive use of the edges through transverse or oblique movements relative to the tool's axis. This evidence is found across all technological categories. Among these, at least three pieces seem to be associated with a multiple use and rejuvenation phase, as indicated by the retouching of rounded edges (fig. 5, c).

Item no. 5099 (fig. 5, c) has very rounded edges, and it was likely used for working abrasive materials, possibly through transverse actions, as indicated by the distribution of striations. In this case too, a retouch overlaps the rounded edge, indicating a rejuvenation of the previously used edge. A broken burin spall (no. 5093) seems to represent the rejuvenation of a tool extensively used on hard, abrasive materials. Wear traces following spall extraction suggest the item was possibly reused in a later phase, extending its functional lifespan.

Longitudinal use-wear traces are less frequent and almost entirely related to the processing of soft or non-abrasive materials. In several cases, these traces are found on both faces, showing bifacial or alternating pattern.

Despite the predominance of use on retouched edges, wear is frequently observed on the opposite edge, particularly on blades and laminar flakes. Additionally, some tools exhibit bilateral retouches or abrasions on both lateral proximal edges, as observed in obsidian tools from La Marmotta (Mineo et al., 2023, fig. 9.1.3.). In some cases, these patterns may be linked to hafting or handling systems, although further investigations at higher magnifications are required.

Four bladelets showed residues with a resinous-pitchy appearance and a brown-yellowish colour (fig. 5, d), linked to use-damage on the opposite edge, as observed in artifacts no. 255 and no. 5179 (fig. 5, d). The presence of such residues is rare in the site assemblage, leading us to exclude a post-depositional origin. However, in the absence of chemical characterization, the nature of these residues cannot be confirmed. Nevertheless, it is noteworthy to highlight the presence of such spots of viscous substances on potentially used tools.

In conclusion, the preliminary analysis of the obsidian assemblage from Fornace Cappuccini confirms that this material had a specific functional role and utilitarian value, rather than serving solely as a status-related material. Based on the macro-wear patterns, it appears that obsidian was primarily used for processing soft or non-abrasive materials. Only a few items, mostly laterally retouched blades, show heavily rounded or chipped edges, along with deep striations, indicating their use for processing harder, more abrasive materials.

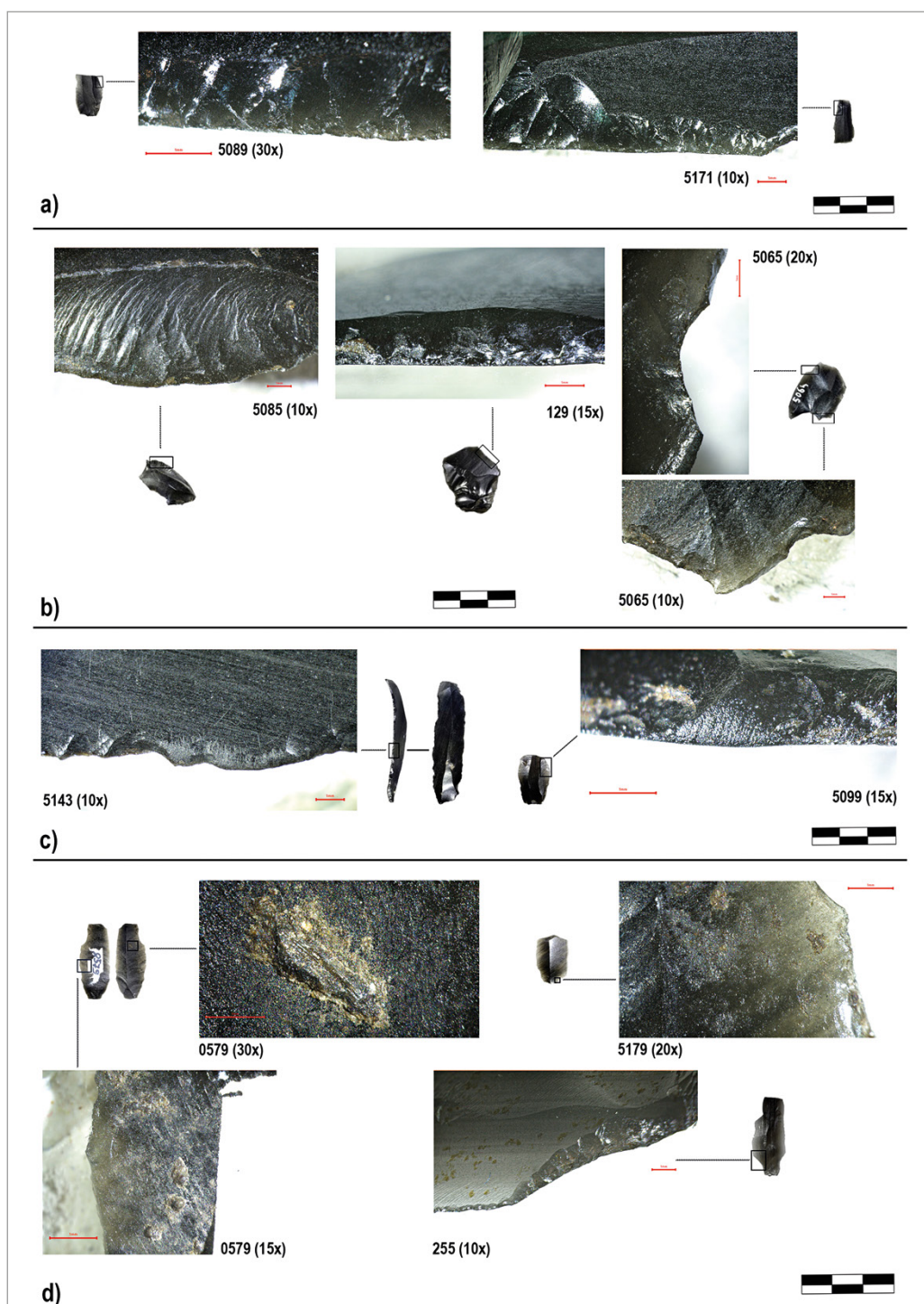


fig. 5. Functional data. a) Abrasions on retouched edges; b) Use-wear on flakes; c) Multiple phases of use and edge rejuvenation; d) Use-wear associated with hafting, with residues on the surfaces. Scale: 3 cm. Microscope images scale (in red): 1 mm.

3.4 Typology

A total of 70 pieces shows evidence of retouching, with the majority being blades (54). Among these, laterally retouched blades are the most common, accounting for 31 items, most of which display marginal (L1) and inframarginal (L1-0, Starnini & Voytek, 1997, p. 351) retouching. There is also a notable presence of backed blades (9 pieces) and oblique truncations (T3) with 6 items. Additionally, significant is the presence of notches and denticulated bladelets, with 11 pieces, mainly represented by type D1. A single burin on a blade (B1) is present, while end scrapers are entirely absent. Scrapers (R1-0, R1, R3) are also represented with six pieces.

4. Discussion

4.1 Fornace Cappuccini in the context of the neolithization of the Po Valley

Fornace Cappuccini was occupied during the second half of the 6th millennium BC, within the context of the northward expansion of groups associated with Impressed Ware from the central Adriatic regions, a process that largely came to a halt in Romagna (southeastern Po Valley) with its late aspects. This same chronological period also marks the formative phase of the Neolithic groups of the Po Valley (Biagi et al., 2020; Starnini et al., 2018), among which Fiorano (Labate, 2006). The northward expansion of Impressed Ware populations may have been halted upon encountering other Neolithic communities (Improta & Pessina, 1998). However, it is important to consider that the distribution of sites in the lower Po Valley could also reflect alterations in sedimentary processes that have taken place since the Holocene (Bruno et al., 2017). Many sites may now lie buried under meters of sediment (Biagi et al., 2020).

However, sites with Fiorano-type pottery show a significant presence of Alpine flint, in contrast to areas beyond the direct influence of Fiorano groups, such as Impressed Ware sites, where it is either absent or found only sporadically (Mengoli, 2011). Likewise, Fiorano sites are notably excluded from the obsidian circulation networks, which appear only episodically and in minimal quantities north of Fornace Cappuccini during the Early Neolithic (Pessina, 1998, 2000).

Within this broader framework of raw material circulation, Fornace Cappuccini represents the northernmost “frontier” of the Adriatic in the diffusion of obsidian. The distribution routes of obsidian thus seem to have been linked to a complex network of relations, which did not uniformly involve all communities and territories.

4.2 Obsidian in the Early Neolithic: Technological and Functional Aspects

The lithic assemblage from Fornace Cappuccini belongs to a broader tradition shared by many *Ceramica Impressa* (Impressed Ware) sites. Pressure flaking, documented across the peninsula and applied to all types of long-distance raw materials, offers a more efficient use of resources compared to percussion (Perlès, 1990). This technique may have been especially preferred for processing exogenous raw materials. However, the pressure technique requires 1) a very vitreous and homogeneous cryptocrystalline rock, and 2) a

considerable investment in terms of skill and learning, implying the need for some degree of artisanal specialization. Specialists in raw materials and flintknapping might have played a key role in the circulation of obsidian, likely acting as primary agents through itinerant mobility (Perlès, 1990, 2004), and they may have spread larger pressure-flaked products. Locally, obsidian may have been exploited in a less specialised manner, using smaller cores, sometimes already nearly exhausted, to produce bladelets, microbladelets, and flakes. Cores are rarely abandoned in earlier knapping phases; more often, they are found in residual and exhausted state, often with hinged removals on the surfaces. Furthermore, the size of the products may, in some cases, have been influenced by the characteristics of the raw material deposition, which, as observed at Palmarola, tends to consist of relatively small blocks (Ceruleo, 1982; Guilbeau, 2022; Radmilli, 1954).

The presence of flakes produced through direct or bipolar-on-anvil percussion suggests that some non-specialised knappers were involved in working raw materials locally. We can therefore hypothesize that not only different production sequences existed, but also different social actors involved in the circulation and knapping of obsidian.

However, larger blades could have been distributed alongside small cores without necessarily implying the presence of itinerant knappers, but rather as part of broader exchange networks that also included other exogenous materials. In fact, the distribution of obsidian may have been managed alongside other non-local materials.

The data suggest that Fornace Cappuccini served more as an “intermediate” site, where obsidian was primarily used and consumed locally, but where small quantities of flakes and blades could also have been redistributed to nearby sites, given the considerable amount of material present. The presence of both blade and flake production sequences, along with their similarity in technological management, flaking techniques, and typology to the flint assemblage, suggests a local management of part of the obsidian tool production.

From a functional perspective, the preliminary macro-wear analysis indicates that part of the assemblage was indeed used, confirming its utilitarian value. The macroscopic evidence of edge damage on several tools provides an initial, albeit partial, interpretation of the functional domains in which obsidian was used within the settlement. The evidence suggests that obsidian was mainly employed for processing soft and fragile materials, primarily using blade tools, although some flakes also show signs of use. In general, harder and more abrasive substances appear to have been worked with other raw materials, such as flint, which was likely more effective for such tasks, for example, cereal harvesting, where more durable materials are more effective (Astruc et al., 2012). Agricultural practices and hunting activities are exclusively associated with flint tools. At Fornace Cappuccini, geometric-backed tools bearing impact traces are present (Mengoli, 2011) and flint sickle inserts are widely attested (Mazzucco et al., 2018).

The functionality of obsidian tools remains an interesting and open topic of research. Data is still scarce, and further analysis is needed. However, some studies seem to suggest that specific behaviours were employed depending on the context. A combined study of experimental and archaeological samples from Sardinia indicates that the physical properties of different obsidian deposits might have been chosen for processing different materials. SC variant was used for working harder inorganic materials and a wider variety of materials compared to the SA sub-source (Setzer,

2004; Setzer & Tykot, 2010). At Contrada Diana in Lipari, there is evidence of the processing of hard materials such as bone and antler, sometimes using formal tools like end scrapers. This evidence should be linked to the fact that obsidian at Lipari was the primary lithic resource (Iovino & Martinelli, 2008). A more specialised use is hypothesised for Grotta dell'Uzzo (TP), where volcanic glass seems to be used for skinning and butchering fish (Iovino, 1997, 2001).

5. Conclusions and perspectives

One of the key differences between the first farming communities and the last hunter-gatherer societies lies in the circulation of exotic and non-local materials, which saw an exponential increase starting in the Neolithic (Barfield, 2000). This shift is tied to other important processes, such as the rise of specialization, which allowed consumers to no longer be directly involved in the production of the goods they used, enabling them to access and utilize raw materials from distant sources just as they would local ones (Perlès, 2012). The selection of high-quality materials becomes increasingly common and new supply strategies are introduced, such as the opening of maritime routes or the extraction of raw materials from mines (Galiberti, 2005). The management of obsidian is thus part of a clear shift in the relationship with landscapes and resources, which is entangled in a network of circuits that do not form part of a unified process.

The circulation of obsidian, as a complex phenomenon, cannot be understood by assuming it was solely intended for special uses, nor by analysing it without distinguishing it from flint industries. The meanings and values that obsidian could assume have been mutable both spatially and diachronically, and it is each society that determines whether a raw material has utilitarian value, serves as a means of social interaction, or is considered a prestige good (Perlès, 2012). Furthermore, objects have biographies and statuses that can change even within the same generation. In fact, a singular model is unable to account for the complexity and variability present in obsidian assemblages. One of the most widely circulated exogenous materials during the Early Neolithic requires further study. One of the main goals of the research will be to standardise data of various types, coming from different research methodologies, to allow both qualitative and quantitative comparisons. It will also be essential to connect provenance data with technological supports to understand the origin and circulation of materials, and how such dynamics evolved over time, refining chronologies with new dating programs. Finally, expanding the availability of traceological data will be crucial to highlight similarities and differences at various analytical scales⁴.

⁴ The review study of the obsidian materials from Fornace Cappuccini was carried out as part of the PRIN 2022 project “CHRONOS – The obsidian route in the central Mediterranean: DiaCHRONic pathways and cultural connectiONS” (Project code 2022JLC8SF CUP I53D23000080006), funded by the European Union-Next GenerationEU coordinated by the University of Pisa and in cooperation with the University of Cagliari. The project's aim is to investigate the circulation patterns of obsidian in the Mediterranean during the Neolithic, modelling data of different types from various chrono-cultural contexts.

References

- Ammerman, A. J., Shaffer, G. D., & Hartmann, N. (1988). A Neolithic Household at Piana di Curinga, Italy. *Journal of Field Archaeology*, 15(2), 121-140.
- Antoniazzi, A., Bagolini, B., Bermond Montanari, G., Massi Pasi, M., & Prati, L. (1987). Il Neolitico di Fornace Cappuccini a Faenza e la Ceramica Impressa in Romagna. In *Atti della XXVI riunione scientifica*, Vol. II (pp. 553-564). Istituto Italiano di Preistoria e Protostoria.
- Antoniazzi, A., Bermond Montanari, G., Giusberti, G., Massi Pasi, M., Mengoli, D., Morico, G., & Prati, L. (1990). Lo scavo preistorico a Fornace Cappuccini. In M. Maioli, M. Massi Pasi, & S. Gelichi (eds.), *Archeologia a Faenza: Ricerche e scavi dal Neolitico al Rinascimento. Catalogo della mostra*. Nuova Alfa Editoriale.
- Astruc, L., Ben Tkaya, M., Torchy, L., Altinbilek, C., Balci, S., Bontemps, C., Gassin, B., Ducret, S., Kayacan, N., Kayan, K., Kurt, N., Oral, O., Özbaşaran, M., Pelegrin, J., Rodriguez Rodriguez, A., & Toprak, Ö. (2012). De l'efficacité des faucilles néolithiques au Proche-Orient: approche expérimentale. *Bulletin de la Société préhistorique française*, 109(4), 671-687. <https://doi.org/10.3406/bspf.2012.14202>
- Bagolini, B., & von Eles, P. (1978). L'insediamento neolitico di Imola e la corrente culturale della ceramica Impressa nel medio e alto Adriatico. *Preistoria Alpina* 14, 33-63.
- Bagolini B., & Ghirotti, L. (1980). La Cultura della Ceramica Impressa a Misano Adriatico (Forlì): aspetti del Neolitico della Romagna. *Preistoria Alpina* 16: 31-43.
- Bagolini, B., & Biagi, P. (1987a). Il Neolitico dell'Emilia-Romagna. In *Atti della XXVI riunione scientifica*, Vol. II (pp. 217-227). Istituto Italiano di Preistoria e Protostoria.
- Bagolini, B., & Biagi, P. (1987b). The first Neolithic chipped stone assemblages of Northern Italy. In J.K. Kozłowski & S.K. Kozłowski (eds.), *Archeologia Interregionalis. Papers delivered at the International "Chipped stone industries of the Early Farming Cultures in Europe*. Varia, Vol. CCXL, 423-448.
- Bagolini, B., & Biagi, P. (1990). The radiocarbon chronology of the Neolithic and Copper age of northern Italy. *Oxford Journal Of Archaeology* 9(1), 1-23.
- Bagolini, B., DeLucca, O., Ferrari, A., Pessina, A., & Wilkens, B. (1991). Insediamenti neolitici ed eneolitici di Miramare (Rimini). *Preistoria Alpina*, 25, 53-120.
- Barfield, L. (2000). Commercio e scambio nel Neolitico dell'Italia settentrionale. In A. Pessina & G. Muscio (eds.), *La Neolitizzazione tra oriente e occidente. Atti del Convegno di Studi, Udine 23-24 aprile 1999* (pp. 55-66). Edizioni del Museo Friulano di Storia Naturale.
- Bermond Montanari, G., & Massi Pasi, M. (1998). New data on the Neolithic Age in Romagna. *Preistoria Alpina*, 34, 263-269.
- Bermond Montanari, G. (2000). Datazioni radiometriche della stazione di Fornace Cappuccini (Faenza, Ravenna). In P. Biagi (ed.), *Studi sul Paleolitico, Mesolitico e Neolitico del bacino dell'Adriatico in ricordo di Antonio M. Radmilli*. Società per la Preistoria e Protostoria della Regione Friuli-Venezia Giulia, Quaderno 8, 21-26.
- Biagi, P., Starnini, E., Boric', D., & Mazzucco, N. (2020). Early Neolithic settlement of the Po Plain (northern Italy): Vhò and related sites. *Documenta Praehistorica*, XLVII, 192-221.
- Bigazzi, G., & Radi, G. (2003). L'ossidiana in Abruzzo durante il Neolitico. In *Atti della XXXVI Riunione Scientifica: Preistoria e Protostoria dell'Abruzzo, Chieti-Celano 27-30 settembre 2001* (pp. 619-624). Istituto Italiano di Preistoria e Protostoria.
- Brito-Abrante, I., & Rodríguez-Rodríguez, A. (2024). Use-Wear Analysis of Obsidian and Other Volcanic Rocks: An Experimental Approach to Working Plant Resources. *Journal of Archaeological Method and Theory*, 31(4), 1873-1916.
- Bronk Ramsey, C., & Lee, S. (2013). Recent and Planned Developments of the Program OxCal. *Radiocarbon*, 55, 720-730.

- Bruno, L., Bohacs, K. M., Campo, B., Drexler, T. M., Rossi, V., Sammartino, I., Scarponi, D., Hong, W., & Amorosi, A. (2017). Early Holocene transgressive palaeogeography in the Po coastal plain (northern Italy). *Sedimentology*, 64, 1792-1816.
- Ceruleo, P. (1982). La stazione litica di Setteville di Guidonia (Roma). *Studi per l'ecologia del Quaternario*, 4, 67-70.
- Farr, H. (2006). Seafaring as social action. *Journal of Maritime Archaeology*, 1, 85-99.
- Clemente Conte, I., Lazuén Fernández, T., Astruc, L., & Rodríguez Rodríguez, A. C. (2014). Use-wear analysis of nonflint lithic raw materials: The cases of quartz/quartzite and obsidian. In *Use-wear and residue analysis in archaeology* (pp. 59-81). Cham: Springer International Publishing.
- Finocchiaro, C. (2023). Approccio chimico analitico allo studio delle sostanze adesive sui falcetti neolitici. Master degree diss. University of Pisa.
- Galiberti, A. (ed.). (2005). *Defensola. Una miniera di selce di 7000 anni fa*. Protagon Editori Toscani.
- Gibaja, J. F., & Mazzucco, N. (2023). Lithic implements used to work cereal and other non-ligneous plants from Sarakenos Cave, Boeotia, Greece. In A. Sampson & T. Tsourouni (eds.), *The Sarakenos Cave at Akraephnion, Boeotia, Greece: From the Middle Palaeolithic to the end of the Bronze Age* (Vol. IV, pp. 249-264).
- Grace, R. (1996). Review Article Use-Wear Analysis: The State of the Art. *Archaeometry*, 38(2), 209-229.
- Guilbeau, D. (2022). Analyse du matériel lithique de la Marmotta – études 2019, 2021 et 2022. Unpublished.
- Hurcombe, L. M. (1992a). *Use wear analysis and obsidian: Theory, experiments and results* (4th ed.). Sheffield Archaeological Monographs, University of Sheffield Department of Archaeology and Prehistory.
- Hurcombe, L. (1992b). New contributions to the study of the function of Sardinian obsidian artifacts. *Sardinia in the Mediterranean: a footprint in the sea. Sheffield Academic, Sheffield*, 83-97.
- Kononenko, N. (2011). Experimental and archaeological studies of use-wear and residues on obsidian artefacts from Papua New Guinea. *Technical Reports of the Australian Museum, Online*, 21(February), 1-244.
- Improta, S., & Pessina, A. (1998). La neolitizzazione dell'Italia settentrionale. Il nuovo quadro cronologico. In A. Pessina & G. Muscio (eds.), *Settemila anni fa il primo pane. Ambienti e culture delle società neolitiche*. Catalogo della mostra (pp. 107-116). Comune di Udine, Museo friulano di Storia naturale.
- Inizian, M. L., Reduron, M., Roche, H., & Tixier, J. (1999). *Technology and terminology of knapped stone*. Cercle de Recherches et d'Étude Préhistoriques.
- Iovino, M.R. (1997). La funzione dell'ossidiana: Un approccio sperimentale al problema, *Origini*, XX, 71-107.
- Iovino, M.R. (2000). Attività agricole nei siti neolitici della Sicilia orientale. In A. Pessina & G. Muscio (eds.), *La Neolitizzazione tra oriente e occidente*. Atti del Convegno di Studi, Udine 23-24 aprile 1999 (pp. 513-522). Edizioni del Museo Friulano di Storia Naturale.
- Iovino, M.R. (2001). Il contributo degli studi funzionali sulle industrie litiche in ossidiana nell'analisi dello sfruttamento preistorico delle risorse marine: Grotta dell'Uzzo (TP), *Rivista di Scienze Preistoriche LI, 2000-2001*, 423-431.
- Iovino, M.R., Martinelli, M.C. (2008). Production and function(s) of obsidian tools at the Neolithic site of Contrada Diana (Aeolian Islands, Sicily). In L. Longo & N. Skakun (eds.), *'Prehistoric Technology' 40 years later: Functional Studies and the Russian Legacy*. Proceedings of the International Congress, Verona (Italy), 20-23 April 2005 (pp. 439-443). BAR International Series 1783.

- Labate D., ed. (2006). Fiorano e la Valle del torrente Spezzano. Archeologia di un territorio. Quaderni di archeologia dell'Emilia Romagna 14.
- Laplace, G. (1964). *Essai de typologie systématique*. Annali Univ. Ferrara, sez. 15, suppl. al vol. I.
- Lemorini, C. (2007). Il sito di Sant'Anna di Oria (Brindisi): risultati dell'analisi funzionale dell'industria litica scheggiata. In I. Tiberi (ed.), *Sant'Anna (Oria-Br). Un sito specializzato del VI millennio a.C.* (pp. 118-123). Congedo Editore.
- Leroi-Gourhan, A. (1964). *Le Geste et la Parole. I, Technique et Langage*. Michel, coll. Sciences d'aujourd'hui.
- Martinelli, M. C., Tykot, R. H., & Vianello, A. (2019). Lipari (Aeolian Islands) Obsidian in the Late Neolithic. Artifacts, Supply and Function. *Open Archaeology*, 5, 46-64.
- Mazzucco, N., Capuzzo, G., Pannocchia, C. P., Ibáñez, J. J., & Gibaja, J. F. (2018). Harvesting tools and the spread of the Neolithic into the Central-Western Mediterranean area. *Quaternary International*, 470, 511-528.
- Mazzucco, N., Ibáñez, J. J., Capuzzo, G., Gassin, B., Mineo, M., & Gibaja, J. F. (2020). Migration, adaptation, innovation: The spread of Neolithic harvesting technologies in the Mediterranean. *PloS one*, 15(4), e0232455.
- Mengoli, D. (2011). *Fornace Cappuccini (Faenza): Un complesso litico della Ceramica Impressa Medio Adriatica*. Tesi di dottorato. Università degli Studi di Siena.
- Mengoli D, Mazzucco N. (2019) – Mursia (Pantelleria): industria litica scheggiata della struttura B14, Rivista di Scienze Preistoriche LXVIII: 425-458.
- Mineo, M., Mazzucco, N., & Gibaja, J. (2023). The submerged site of La Marmotta (Rome, Italy).
- Odell, G. H. (1987). Analyse fonctionnelle des traces d'usure effectuée à une échelle régionale: l'Illinois. *L'Anthropologie*, 91(2), 381-398.
- Odell, G. H. (2001). Stone tool research at the end of the millennium: classification, function, and behavior. *Journal of Archaeological Research*, 9, 45-100.
- Odell, G. H., & Odell-Vereecken, F. (1980). Verifying the reliability of lithic use-wear assessments by 'blind tests': the low-power approach. *Journal of field Archaeology*, 7(1), 87-120.
- Pearce, M. (2008). Structured Deposition in Early Neolithic Northern Italy. *Journal of Mediterranean Archaeology*, 21(1), 19-33. <https://doi.org/10.1558/jmea.v21i1.19>
- Perlès, C. (1990). L'outillage de pierre taillée néolithique en Grèce: approvisionnement et exploitation des matières premières. *Bulletin de correspondance hellénique*, 114(1), 1-42.
- Perlès, C. (2004). *The early Neolithic in Greece: The first farming communities in Europe*. Cambridge University Press.
- Perlès, C. (2012). Le statut des échanges au néolithique. In Congrès Internacional Xarxes al Neolític – Neolithic Networks. *Rubricatum. Revista del Museu de Gavà*, 5, 539-546.
- Pessina, A. (1998). Aspetti culturali e problematiche del primo Neolitico dell'Italia settentrionale. In A. Pessina & G. Muscio (eds.), *Settemila anni fa il primo pane. Ambienti e culture delle società neolitiche*. Catalogo della mostra (pp. 95-106). Comune di Udine, Museo friulano di Storia naturale.
- Pessina, A. (2000). Il primo Neolitico dell'Italia settentrionale: problemi generali. In A. Pessina & G. Muscio (eds.), *La Neolitizzazione tra oriente e occidente*. Atti del Convegno di Studi, Udine 23-24 aprile 1999 (pp. 81-90). Edizioni del Museo Friulano di Storia Naturale.
- Radmilli A. M. (1954). Le Isole Pontine e il commercio dell'ossidiana nel continente durante il neo-eneolitico, in Origines, Raccolta di scritti in onore di Mons. Giovanni Baserga, Tipografia Editrice Antonio Nosedà, Como, 115-129.
- Reimer, P. J., Austin, W. E. N., Bard, E., Bayliss, A., Blackwell, P. G., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kromer, B., Manning, S. W., Muscheler, R. et al.

- (2020). The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0-55 cal kBP). *Radiocarbon*, 62(4), 725-757. <https://doi.org/10.1017/RDC.2020.41>
- Setzer, T. J. (2004). *Use-wear experiments with Sardinian obsidian: Determining its function in the Neolithic*. Graduate thesis. University of South Florida.
- Setzer, T. (2012). Use-wear Experiments with Obsidian. *Lithic Technology*, 37(1), 35-46.
- Setzer, T. J., & Tykot, R. H. (2010). Considering the source: The importance of raw material characterization and provenance in obsidian use-wear studies. In C. Lugliè (ed.), *L'ossidiana del Monte Arci nel Mediterraneo. Nuovi apporti sulla diffusione, sui sistemi di produzione e sulla loro cronologia*. Atti del 5° Convegno internazionale, Pau, Italia, 27-29 Giugno 2008 (pp. 71-84). NUR.
- Starnini, E., & Voytek, B. (1997). The Neolithic chipped stone artefacts from the Bernabò Brea-Cardini excavations. In R. Maggi, E. Starnini, B.A. Voytek (eds.), *Arene Candide: A functional and environmental assessment of the Holocene sequence excavated by L. Bernabò Brea (1940-50)* (pp. 349-426). Memorie dell'Istituto Italiano di Paleontologia Umana 5. Il Calamo.
- Starnini, E., Biagi, P., & Mazzucco, N. (2018). The beginning of the Neolithic in the Po Plain (northern Italy): Problems and perspectives. *Quaternary International*, 470, 301-317.
- Terradas, X., Gratuze, B., Bosch, J., Enrich, R., Esteve, X., Oms, F. X., & Ribé, G. (2014). Neolithic diffusion of obsidian in the western Mediterranean: New data from Iberia. *Journal of Archaeological Science*, 41, 69-78.
- Tixier, J. (ed.). (1984). *Préhistoire de la pierre taillée 2: économie du débitage laminaire: technologie et expérimentation*. III table ronde de technologie lithique, Meudon-Bellevue octobre 1982. Cercle de Recherches et d'Étude Préhistoriques.
- Tringham, R., Cooper, G., Odell, G., Voytek, B., & Whitman, A. (1974). Experimentation in the formation of edge damage: a new approach to lithic analysis. *Journal of field archaeology*, 1(1-2), 171-196.
- Tykot, R. H. (2017). Obsidian studies in the prehistoric Central Mediterranean: After 50 years, what have we learned and what still needs to be done? *Open Archaeology*, 3, 264-278.
- Tykot, R. H., Iovino, M.R., Martinelli, M.C. & Beyer, L. (2006) – Ossidiana da Lipari: Le fonti, la distribuzione, la tipologia e le tracce d'usura. In *Atti della XXXIX Riunione Scientifica: Materie prime e scambi nella preistoria Italiana*, Firenze, 25-27 novembre 2004 (pp. 595-596). Istituto Italiano di Preistoria e Protostoria.
- Walton, D. P. (2019). An experimental program for obsidian use-wear analysis in central Mexican archaeology. *Journal of Archaeological Method and Theory*, 26(3), 895-942.

Fabio Squarcini Berti*, Lorena Bravi**

* Dipartimento di Civiltà e Forme del Sapere, Università di Pisa.

** Dipartimento di Scienze dell'Antichità, Sapienza Università di Roma.

DAI *LEGACY DATA* ALLA DIGITALIZZAZIONE E ANALISI. UN DATABASE PER LO STUDIO DELLA DISTRIBUZIONE DEI RINVENIMENTI DI EPOCA ETRUSCA NELL'AREA DEL MEDIO VALDARNO

Abstract: This contribution aims to analyse the use of legacy data, extracted from bibliographic sources to study and represent, through graphic-spatial tools, the distribution of archaeological finds in the Middle Valdarno. Through exploratory spatial analyses conducted with QGIS and R, and organised by chronological phases, it has been possible to identify a strongly clustered settlement pattern, spanning from the Iron Age to the late Hellenistic period. In particular, the analyses conducted using Kernel

Density Estimation (KDE), Point Pattern Analysis (PPA), and Nearest Neighbour Index (NNI) have highlighted significant variations in the areas of settlement concentration: in the earlier periods, finds are distributed in clusters in areas of higher altitude, while in later periods, a shift towards lower elevations is observed, accompanied by increasing spatial dispersion.

Keywords: Archaeology, Etruscology, Spatial Analysis, QGIS, R.

1. Introduzione

Il presente contributo si propone di offrire una rappresentazione grafico-spaziale dei *legacy data* raccolti durante un lavoro di tesi (Squarcini Berti, 2022), in cui sono stati documentati tutti i ritrovamenti archeologici nell'area del medio Valdarno. Per rappresentare in modo dettagliato le zone di rinvenimento dei reperti, è stato necessario digitalizzare e strutturare i dati ottenuti tramite ricerca bibliografica, esaminando anche la distribuzione dei ritrovamenti. Questo approccio ha richiesto tecniche avanzate di sistematizzazione dei dati, consentendo un'analisi accurata della loro distribuzione con strumenti di analisi spaziale esplorativa, al fine di individuare le aree di maggiore concentrazione per le diverse fasi cronologiche.

L'analisi dei *legacy data* presenta sfide metodologiche, in particolare per la loro interpretazione e affidabilità. Come sottolineato da Huggett (2022), tali dati non

sono oggettivi e immutabili, essendo soggetti a interpretazioni che ne influenzano la natura. Inoltre, la digitalizzazione e le infrastrutture tecnologiche possono alterarne la forma originaria, con interpretazioni nuove e differenziate. Huggett (2022) evidenzia anche l'importanza di un approccio critico nell'impiego di questi dati, bilanciando le opportunità offerte dalle tecnologie digitali con la consapevolezza delle loro limitazioni.

L'integrazione dei *legacy data* tramite tecniche GIS consente di visualizzare l'evoluzione insediativa nel paesaggio antico, ma deve essere fatta con un atteggiamento critico, come sottolineano Casarotto et al. (2019). Per questo motivo è stato fondamentale identificare metodologie efficaci per l'estrazione, la gestione e la valorizzazione dei dati, riducendo al minimo l'errore interpretativo, andando a sviluppare tecniche di digitalizzazione che si adattassero alla variabilità e incertezza di queste informazioni, estraendone il massimo valore possibile.

Inoltre, la localizzazione delle aree di interesse presenta problematiche poiché i dati storici non sono dotati di coordinate precise. È stato quindi necessario sviluppare una metodologia per migliorare l'accuratezza spaziale e garantire una localizzazione più precisa delle aree, permettendo analisi che identificassero zone di maggiore concentrazione. Ciò ha comportato l'adozione di tecniche avanzate di georeferenziazione, integrando informazioni spaziali con quelle storiche e archeologiche. L'obiettivo finale è stato ottenere una rappresentazione accurata della distribuzione dei reperti, e fornire un supporto per future analisi spaziali e interpretazioni sulle dinamiche insediative del medio Valdarno, tenendo conto delle variabili cronologiche.

2. Materiali e Metodi

I dati bibliografici sono stati organizzati in un censimento numerato, strutturato in base alla localizzazione dei ritrovamenti e suddiviso per macroaree geografiche, che corrispondono alle diverse valli della Valdera, del Valdarno, della Val d'Egola e della Val d'Elsa. L'area del medio Valdarno (fig. 1), situata nella Toscana nord-occidentale, si estende tra Pontedera e la confluenza del fiume Era nell'Arno a ovest, Fucecchio a nord, San Miniato e la Val d'Egola a est, e Casciana Terme a sud.

Questa regione, denominata la 'Terra dei Quattro Fiumi', è un'area geograficamente complessa, racchiusa da tre corsi d'acqua principali. Il fiume Arno, che scorre al centro della valle, è circondato da una serie di rilievi: a nord dalle Cerbaie e a sud da una dorsale collinare. Il paesaggio è solcato dai fiumi Egola, Chiecina ed Era, che definiscono la struttura idrografica prima che l'Arno si apra verso la pianura di Pisa.

A nord, ai piedi delle Cerbaie, scorre l'Usciana, un fiume incanalato in rettilinei creati dalle bonifiche granducali del Cinquecento, che confluisce nell'Arno poco a monte di Pontedera. Questo fiume conserva ancora le caratteristiche di un antico corso d'acqua, il cui letto è mutevole e meandriforme. Intorno all'anno Mille, il fiume Usciana era noto con il nome etrusco di *Arme*, che indicava il corso d'acqua che drenava le acque della Nievole e delle due Pescie (di Pescia e di Collodi).

A ovest scorre il fiume Era, che, insieme ai suoi affluenti Roglio e Cascina, si dirige verso l'acropoli di Volterra e verso la Toscana centro-meridionale (Ciampoltrini & Grassini, 2011, pp. 15-16). Infine, a est, l'area oggetto di indagine è delimitata dal

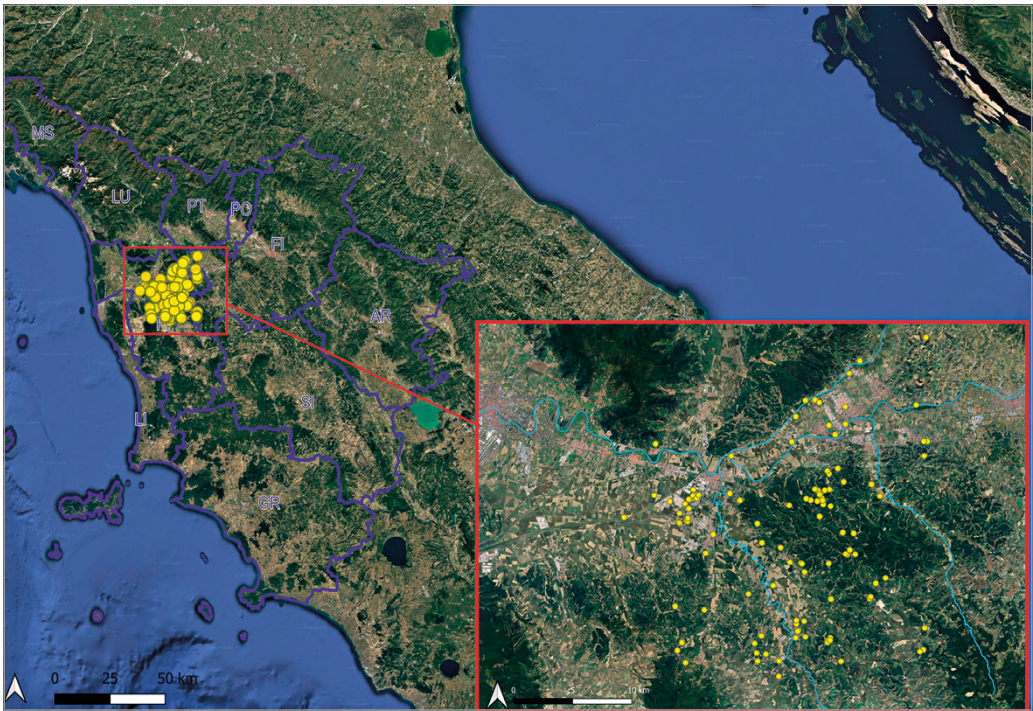


fig. 1. Mappa geografica dell'area del medio Valdarno.

fiume Egola, che confluisce anch'esso nell'Arno, contribuendo ulteriormente alla definizione dei confini geografici della regione.

Le aree di interesse sono state catalogate seguendo una successione geografica da ovest verso est. Ogni sito archeologico è contrassegnato dalla sigla 'S.' seguita da un numero progressivo arabo, e accompagnato da una scheda dettagliata. Questa scheda include diverse sezioni, ognuna delle quali fornisce informazioni approfondite sull'area archeologica in esame: comune, tipologia e anno di indagine, ubicazione e descrizione del sito, materiali, periodo/fase, interpretazione e bibliografia (Squarcini Berti, 2022).

Il progetto nasce dalla consapevolezza della necessità di migliorare la chiarezza e la completezza delle informazioni raccolte, che richiedono un lavoro di organizzazione più approfondito per essere adeguatamente utilizzate ed analizzate. Per rispondere a questa esigenza è sembrato opportuno digitalizzare i dati e organizzarli in un DB, riconosciuto come lo strumento più idoneo per la sua capacità di garantire flessibilità e integrazione di informazioni eterogenee, adattandosi così alle diverse esigenze analitiche del progetto. Questa scelta non solo consente di rendere i dati più coerenti, ma favorisce anche una consultazione rapida e un'analisi approfondita, facilitando la lettura critica e l'individuazione di correlazioni. Permette, inoltre, di apportare aggiornamenti futuri e di migliorarne l'interoperabilità con altri strumenti digitali.

In questo contesto, sono stati esplorati metodi di strutturazione e gestione dei dati che hanno permesso di preservare l'integrità di ciascun dato, integrando anche strumenti GIS per geolocalizzare i ritrovamenti, creare visualizzazioni ed analisi che consentano di valorizzare la loro rilevanza storica e archeologica. L'adozione di

linguaggi di programmazione, come *R*, ha consentito, tramite l'attuazione sempre di analisi spaziali, di trasformare questi dati in risorse attive, capaci di fornire nuovi spunti interpretativi. Questo approccio, basato su dati concreti e oggettivi, senza sovra interpretazioni, consente di costruire conoscenze più approfondite e sfumate, con particolare riferimento, nel caso in oggetto, al contesto dell'Etruria nord-occidentale.

2.1 Dal Catalogo al *Database*

Per raggiungere l'obiettivo preposto, è stato necessario trasferire il catalogo, contenente 94 'Siti', attraverso un processo di digitalizzazione manuale in un database più efficiente, in grado di strutturare le informazioni per renderle rapidamente e intuitivamente comprensibili, consultabili, gestibili, ricercabili, analizzabili e condivisibili.

Questo processo è stato svolto mediante l'utilizzo del *software* Microsoft Excel¹, che ha facilitato una strutturazione dell'informazione che fosse sia coerente con gli obiettivi sia rivolta a un pubblico generico che ne potesse trarre una facile lettura e utilizzo. Il database creato si compone di diciotto campi, che sono stati successivamente collegati a uno SHP poligonale generato con il *software open source* QGIS, utilizzando una chiave primaria (*QGIS overview · QGIS Web Site*, 2025). La scelta di utilizzare uno SHP poligonale è stata dettata dalla necessità di rappresentare in modo più preciso possibile le aree di ritrovamento, soprattutto nei casi in cui la posizione esatta dei reperti non fosse nota. In particolare, per i siti con localizzazione incerta, è stato deciso di delimitare un'area di possibile interesse piuttosto che attribuire un punto arbitrario, evitando così un'interpretazione eccessiva dei dati. Questa scelta metodologica, adottata come prima fase del progetto, ha permesso di ridurre al minimo il rischio di sovra-interpretazione e di mantenere la coerenza con l'incertezza delle informazioni disponibili.

I campi del database sono i seguenti:

- ID: campo numerico che definisce una chiave primaria univoca assegnata a ciascun ritrovamento, che ne consente l'identificazione individuale.
- LOCALITÀ: campo testuale che indica la località del ritrovamento.
- COMUNE: campo testuale che indica il comune del ritrovamento.
- PROVINCIA: campo testuale che indica la provincia del ritrovamento.
- ANNO_INDAGINE: campo numerico che riporta l'anno o gli anni in cui si è svolta l'indagine.
- CRONO_INIZIALE: campo numerico che indica l'anno d'inizio della datazione dei reperti.
- CRONO_FINALE: campo numerico che indica l'anno di fine della datazione dei reperti.
- PERIODO: campo testuale che indica il *range* cronologico in secoli a cui si data il ritrovamento.
- RITROVAMENTI: campo testuale che descrive i reperti trovati nel sito di interesse.
- SITUAZIONE_RITROVAMENTO: campo testuale che indica il contesto in cui sono stati rinvenuti i reperti.

¹ <https://www.microsoft.com/it-it/microsoft-365/excel?market=it>

- **AFFIDABILITÀ:** campo numerico che esprime l'indice di affidabilità dei dati.
- **DESCRIZIONE:** campo testuale che riporta la descrizione del ritrovamento e la sua ubicazione.
- **INTERPRETAZIONE:** campo testuale che fornisce un'interpretazione della tipologia dei ritrovamenti.
- **FASE CRONOLOGICA:** campo testuale che definisce il periodo cronologico di riferimento per i reperti.
- **BIBLIOGRAFIA:** campo testuale che elenca i testi utilizzati per la compilazione della scheda.
- **AUTORE:** campo testuale che contiene il nome e il cognome dell'autore del progetto.
- **COMPILATORE:** campo testuale che contiene il nome e il cognome del compilatore del database.
- **ID_MAGOH:** campo numerico che riporta il numero d'intervento ripreso dal portale MAGOH per ogni ritrovamento.

Inoltre, per rendere i dati uniformi e consistenti, è stato scelto di utilizzare vocabolari standardizzati provenienti dal portale MAGOH², per il campo 'Interpretazione' (II livello) e il vocabolario OGT dal portale GNA³ (Geoportale Nazionale Archeologia) per il campo 'Situazione di Ritrovamento'. Questo ha consentito di rendere i dati uniformi, consistenti, interoperabili, efficienti e facilmente ricercabili, rendendo il database uno strumento più potente e affidabile.

È stato inoltre ritenuto opportuno aggiungere un campo denominato "Affidabilità" per indicare il livello di attendibilità associato al riferimento di ciascun ritrovamento. Come riferimento, sono stati consultati i gradi di affidabilità definiti dal sistema Mappa GIS, basati, principalmente su tre livelli, divisi in sei categorie. Dato che la documentazione proviene esclusivamente da fonti bibliografiche, è stato scelto di utilizzare come riferimento la categoria 'Relazione' secondo Fabiani & Gattiglia (2012, pp. 49-50). Partendo da questa base, sono stati sviluppati tre criteri per definire il grado di affidabilità dei rinvenimenti nell'area oggetto di analisi:

- **Grado 1:** conoscenza limitata del ritrovamento, ottenuta tramite una ricerca circoscritta al singolo sito. La descrizione del luogo di rinvenimento è sufficiente, ma manca materiale archeologico; quindi, l'interpretazione si concentra soprattutto sul contesto generale.
- **Grado 2:** conoscenza moderata del ritrovamento, acquisita attraverso una ricerca su una piccola porzione di territorio. La descrizione del materiale rinvenuto è buona, permettendo un'interpretazione che si basa principalmente sul materiale stesso.
- **Grado 3:** conoscenza approfondita del ritrovamento, ottenuta mediante una ricerca su un ampio territorio. La descrizione del materiale rinvenuto è dettagliata, consentendo un'interpretazione completa basata sia sul contesto che sui reperti archeologici.

² <https://magoh.cfs.unipi.it/en/web/guest>

³ https://gna.cultura.gov.it/wiki/index.php/Pagina_principale

Durante la digitalizzazione del catalogo, è emersa una problematica: molti ‘Siti’ contenevano al loro interno più aree di ritrovamento, molto vicine tra loro, ma identificate con localizzazioni differenti dentro la voce ‘Ubicazione e Descrizione del sito’. Per risolvere l’incongruenza è stato necessario suddividere tali ‘Siti’ in più vettorializzazioni poligonali, ciascuna corrispondente a una specifica area di ritrovamento. Questa scelta ha permesso di condurre analisi più dettagliate e precise. Sebbene le aree di rinvenimento condividano gli stessi attributi, si differenziano per la loro specifica localizzazione spaziale⁴. Al termine del processo di digitalizzazione e strutturazione, il DB è stato salvato in formato CSV, facilitando così il suo inserimento come file di testo delimitato all’interno di QGIS.

2.2 Dal *Database* a QGIS

Una volta completato il DB, è iniziato il processo di visualizzazione grafico-spaziale dei dati. È stata condotta una ricerca topografica e geografica per identificare il corretto posizionamento dei siti nel catalogo. Utilizzando il portale MAGOH (Anichini et al., 2023), sono stati scaricati in formato JSON i siti già vettorializzati. Per quelli non identificabili, invece, sono stati utilizzati portali come Retore⁵ per l’analisi toponomastica e Castore⁶ per verificare la presenza di siti nel Catasto Leopoldino del 1765. Inoltre, sono stati impiegati il DTM della provincia di Pisa e la carta idrica (SHP lineare) della Toscana, scaricati da Open Toscana⁷.

Il processo ha seguito un *workflow* metodologico che ha integrato strumenti GIS e analisi spaziali avanzate sviluppate in R. Un nuovo progetto è stato creato in QGIS 3.28.14, con il sistema di riferimento WGS84 (EPSG:4326). I dati da MAGOH sono stati importati in formato JSON, e le aree non identificate sono state vettorializzate manualmente tramite ricerca toponomastica, creando uno SHP poligonale per delimitare l’area di interesse. Durante la vettorializzazione è stato generato un campo attributi numerico chiamato ‘ID’ per semplificare l’associazione con il database. I file di MAGOH, ciascuno dotato di un ID univoco associato al relativo ritrovamento, sono stati importati singolarmente nel *software* e successivamente uniti tramite un’operazione di *merge* complessivo, includendo anche quelli vettorializzati manualmente nel *layer* denominato “poligonale_ID”. Infine, è stato importato il DB come file di testo delimitato. Grazie alla chiave primaria, è stato eseguito un processo di *join*, che ha consentito di combinare i due formati. Il risultato è stato esportato in un terzo file poligonale, denominato “poligonale_ritrov_finale”, corredato di tutte le informazioni presenti nel DB.

Questo processo ha permesso di visualizzare i siti presenti nel catalogo sia in forma grafica che descrittiva, migliorando notevolmente la comprensione e la fruibilità delle informazioni.

⁴ Questa operazione è stata applicata agli ID: 7, 10, 13, 18, 23, 33, 36, 38, 40, 44, 48, 55, 62, 64, 74.

⁵ https://www502.regione.toscana.it/searcherlite/retore_start.jsp

⁶ <https://www502.regione.toscana.it/castoreapp/>

⁷ <https://dati.toscana.it/dataset/>

2.3 Analisi spaziali in QGIS

Per condurre le analisi spaziali esplorative tramite *Point Pattern Analysis* (PPA) (Orton, 2004) in QGIS è stato necessario convertire i poligoni in centroidi, poiché gli algoritmi di *Kernel Density Estimation* (KDE) (Hu, 2025; Nakoinz & Knitter, 2018, pp. 77-81; Ripley, 2005, p. 152; Illian et al., 2008) richiedono di utilizzare solo elementi puntuali per calcolare distribuzioni e concentrazioni. La conversione è stata effettuata tramite il *plugin* ‘Centroidi’, che ha permesso di assegnare un elemento puntuale a ciascun ritrovamento analizzato.

2.3.1 Nearest Neighbor Index

Le analisi di PPA consistono in analisi statistiche volte a comprendere ed evidenziare eventuali tendenze spaziali in una distribuzione di punti, verificando, attraverso coefficienti, se questi siano raggruppati, dispersi in modo regolare o distribuiti casualmente (Basile & Campus, 2023; Gatrell et al., 1996; Kempf & Günther, 2023). Questa analisi è stata condotta utilizzando l'algoritmo *Nearest Neighbor Index* (NNI), reperibile nella Toolbox di Processing di QGIS, applicato al *layer* puntuale filtrato per ciascuna fase cronologica. Dopo aver configurato i parametri richiesti, sono stati calcolati i principali indicatori per definire la tipologia di distribuzione dei punti: la distanza media osservata, la distanza media attesa in condizioni di CSR (*complete spatial randomness*) e il corrispondente NNI, integrato dal test Z-Score (Moore et al., 2009).

2.3.2 Kernel Density Estimation

Dopo aver applicato i filtri per fase cronologica, è stata condotta un'analisi di concentrazione spaziale mediante l'algoritmo di KDE all'interno di QGIS. Per garantire un'elevata precisione, è stata adottata una funzione di kernel quartica, con una risoluzione dei pixel elevata e un raggio di influenza di 5500 m⁸. Quest'ultimo è stato determinato empiricamente dopo diverse prove, in quanto si è rivelato il più adatto a rappresentare la distribuzione dei ritrovamenti nell'area di studio. L'obiettivo principale dell'analisi era l'individuazione di *cluster* locali, motivo per cui si è preferito un valore di sigma relativamente basso. La scelta di questo parametro è stata effettuata in modo empirico, valutando il miglior compromesso tra il livello di dettaglio e la generalizzazione della distribuzione spaziale. L'analisi è stata anche parametrizzata utilizzando il campo ‘Affidabilità’, al fine di considerare il grado di certezza delle evidenze archeologiche. Tali analisi hanno consentito di mettere in luce le aree di maggiore concentrazione dei siti archeologici nelle diverse epoche cronologiche (villanoviana, orientalizzante, arcaica, classica ed ellenistica), tenendo conto dell'affidabilità dei rinvenimenti.

⁸ Inizialmente le analisi sono state effettuate in EPSG:4326 (coordinate geografiche in gradi), ma poiché gli strumenti di analisi spaziale in *spatstat* (R) (§2.4.3) richiedono un sistema metrico, i dati sono stati riproiettati in EPSG:3003. Per garantire la confrontabilità dei risultati, anche in QGIS le analisi KDE sono state eseguite con la stessa proiezione.

2.4 Analisi statistiche e spaziali in R

Per confermare o confutare le analisi condotte in QGIS e garantire un'interpretazione oggettiva, le stesse analisi sono state eseguite anche nel software R-4.4.2⁹. L'elaborazione ha coinvolto sempre l'uso di SHP puntuali, su cui sono state eseguite varie operazioni di analisi spaziale, tra cui:

- *Kernel Density Estimation*: per identificare aree di maggiore concentrazione dei ritrovamenti, pesando i dati in base all'affidabilità;
- *Nearest Neighbor Index*: per valutare la tendenza dei ritrovamenti a disporsi in maniera casuale, aggregata o regolare;
- Funzione K di Ripley: per valutare la densità cumulativa dei punti e per analizzare la presenza di aggregazione o regolarità dei ritrovamenti rispetto a un modello di CSR;
- Funzione G (*nearest neighbor distance distribution*): per misurare la distribuzione delle distanze minime tra ciascun ritrovamento e il suo vicino più prossimo;
- Funzione F (*empty space function*): per analizzare la distribuzione delle distanze del ritrovamento più vicino a un punto scelto casualmente all'interno del campo;
- Funzione J: derivata dalle funzioni F e G, per aiutare a interpretare se i *pattern* qualora identificati siano aggregati, casuali o regolari.

2.4.1 Pre-elaborazione dei dati spaziali

I dati, vettorializzati in QGIS, sono stati importati in R con il pacchetto *sf*, verificando la presenza di attributi chiave (coordinate, altimetria, affidabilità). In una fase preliminare, i dati originariamente in EPSG:4326 sono stati convertiti nel sistema metrico EPSG:3003 (Monte Mario/Italy zone 1), necessario per garantire la corretta interpretazione delle distanze spaziali nelle analisi condotte con il pacchetto *spatstat*. Successivamente, per integrare il dato altimetrico, è stato utilizzato in QGIS l'algoritmo "Contour", applicato al DTM del comune di Pisa, associando a ciascun punto il valore della curva di livello più vicina.

Una volta strutturati i dati, i punti sono stati trasformati in oggetti di tipo PPP, formato richiesto per analisi spaziali quali NNI, KDE e le funzioni K, G, F e J. È stata quindi condotta una fase di normalizzazione e pulizia, con gestione dei valori mancanti e attribuzione di un peso ai ritrovamenti sulla base del loro grado di affidabilità. Infine, è stata definita una finestra spaziale unica per l'intero *dataset*, calcolando il *bounding box* globale e ampliandolo di 3000 m, al fine di ridurre gli effetti di bordo nelle analisi.

2.4.2 Calcolo dell'NNI

Per ogni periodo considerato, i dati sono stati letti in R tramite le librerie *sf*, *spatstat* e *spatstat.geom*. I singoli SHP sono stati importati e convertiti in formato *sf*, dal quale sono state estratte le coordinate (x, y) necessarie per le analisi spaziali. Successivamente, per ciascun insieme di punti è stata definita la 'finestra di osservazione' (*window*) corrispondente al *bounding box* dei dati, e attraverso la funzione PPP è stato creato l'oggetto PPP.

⁹ <https://cran.r-project.org/bin/windows/base/>

Una volta definito il *pattern* di punti, sono state calcolate le distanze dal NNI per ciascun punto (funzione *nn-dist()*), ottenendo la distanza media osservata (*obs_mean*).

Per stimare la densità puntuale, è stata calcolata l'area del *bounding box*, che ha fornito la stima di λ . La distanza media attesa in condizioni di completa casualità spaziale è stata determinata come: $\frac{1}{2\sqrt{\rho}}$ (Clark & Evans, 1954, p. 451).

Infine, il NNI è stato derivato come rapporto tra la distanza media osservata e quella attesa. I valori di NNI inferiori a 1 indicano una tendenza all'aggregazione (*clustering*), i valori intorno a 1 suggeriscono una distribuzione casuale, mentre i valori superiori a 1 denotano una disposizione dei punti più uniforme. Per ciascun periodo, i risultati (numero di punti, area, distanze osservate e attese e relativo NNI) sono stati salvati e stampati, consentendo così un confronto diretto tra i diversi periodi.

2.4.3 Calcolo della *Kernel Density Estimation*

Nelle analisi di KDE (Venables & Ripley, 2002), i dati sono stati ponderati in base all'affidabilità dei ritrovamenti. Inoltre, quest'ultima è stata normalizzata su un intervallo [1, peso], assegnando i valori minimi e massimi rispettivamente ai ritrovamenti meno e più affidabili, evitando così l'assegnazione di valori negativi. La scelta della banda di *smoothing* (σ) è stata ottimizzata testando valori compresi tra 2000 e 5000 m, con incrementi di 500 m, per bilanciare dettaglio locale e generalizzazione spaziale, al fine di ottenere una rappresentazione della densità spaziale il più accurata possibile. In aggiunta, l'affidabilità è stata normalizzata su una scala applicando un peso¹⁰ maggiore ai punti più affidabili. Questo ha migliorato la precisione della KDE, riducendo l'impatto dei dati meno affidabili e ha consentito di focalizzarsi sulle aree "più sicure", migliorando ulteriormente l'accuratezza della densità spaziale stimata. Le mappe KDE sono state generate per ogni periodo, valore di σ e peso di affidabilità, e visualizzate utilizzando il pacchetto *ggplot2* (Wickham, 2006), con una scala cromatica progressiva. I risultati sono stati esportati in formato PNG per consentire un confronto visivo tra le diverse combinazioni di parametri.

2.4.4 Analisi integrata delle funzioni spaziali ponderate (K di Ripley, G, F, J) per l'affidabilità dei ritrovamenti

Per approfondire la comprensione delle caratteristiche della distribuzione spaziale dei ritrovamenti archeologici, i dati originali in formato *shapefile* sono stati importati e gestiti con la libreria *sf*. Successivamente, le coordinate spaziali (x, y) sono state estratte per creare oggetti di classe PPP, integrando finestra spaziale predeterminata definita per assicurare uniformità e comparabilità tra i vari periodi storici. Poiché ciascun punto corrisponde a un ritrovamento archeologico caratterizzato da un livello variabile di affidabilità, è stato indispensabile, anche in questo caso, attribuire a ogni singolo punto un peso specifico. Pertanto, è stato applicato un processo di normalizzazione dei valori di affidabilità, scalati nell'intervallo [0,1]. Successivamente, tramite un parametro definito "peso_values"¹¹, è stato possibile modificare la scala di questi

¹⁰ `c(0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9)`.

¹¹ `Peso_values <- c(0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9)`.

valori normalizzati, producendo pesi ponderali (*marks*) capaci di enfatizzare in modo differenziale i ritrovamenti più affidabili.

L'analisi è stata svolta implementando congiuntamente quattro differenti funzioni spaziali fondamentali: G, F, J e K di Ripley (Diggle, 2013; Baddeley et al., 2016) ciascuna con specifiche configurazioni di calcolo. In dettaglio, per ogni periodo e valore di peso considerato, la funzione G(r) è stata stimata mediante la funzione *Gest()* del pacchetto *spatstat*, applicando una correzione per i bordi (*border*) per ridurre distorsioni dovute agli effetti di margine. Analogamente, la funzione F(r) è stata calcolata con la funzione *Fest()*, mentre la funzione J(r), derivata dalla relazione tra le funzioni precedenti, è stata stimata utilizzando la funzione *Jest()*. Infine, la funzione K di Ripley (K(r)) è stata determinata tramite la funzione *Kest()* con correzione di tipo Ripley. Le funzioni K e G sono state calcolate su intervalli di distanza compresi tra 0 e 5000 m, con incrementi regolari di 50 m, mentre le funzioni F e J sono state calcolate sempre con gli stessi intervalli di distanza ma con incrementi regolari di 20 m per garantire una risoluzione ottimale delle informazioni spaziali e una comparabilità accurata tra i diversi periodi storici e valori di peso considerati.

Per verificare la robustezza statistica dei risultati ottenuti e valutare in modo accurato eventuali deviazioni dalla casualità spaziale, sono stati generati *envelope* di confidenza mediante simulazioni Monte Carlo con un numero variabile di iterazioni (99, 1000 e 5000 simulazioni). Tale strategia metodologica consente, infatti, di ottenere intervalli di confidenza progressivamente più stabili e precisi all'aumentare del numero di simulazioni, riducendo l'incertezza legata al campionamento casuale del processo di riferimento (CSR). Ad esempio, con sole 99 simulazioni si ottengono bande di confidenza ampie, il che rende meno affidabile l'individuazione di *pattern* significativi. Aumentando il numero di iterazioni a 1000 o 5000, tali bande si restringono sensibilmente, consentendo una maggiore precisione nell'identificazione di fenomeni spaziali non casuali. In aggiunta, la scelta di un passo di discretizzazione delle distanze rappresenta un compromesso ottimale tra risoluzione spaziale e computazionale. Le funzioni K e G si basano su calcoli cumulativi o integrali, che generalmente risultano meno sensibili alla discretizzazione della variabile di distanza r. In altre parole, incrementi di 50 m sono sufficienti per ottenere stime stabili e accurate. Al contrario, le funzioni F e J si basano sulla distribuzione delle distanze minime (o sulla loro derivata) e sono molto più sensibili alla risoluzione del vettore r. Se il passo è troppo ampio (come 50 m), la griglia non è abbastanza fine per catturare tutte le variazioni locali, portando a stime imprecise o addirittura alla restituzione di valori NA. Per questi metodi è necessario utilizzare incrementi molto più piccoli (ad esempio, intorno a 20-25 m) per garantire una discretizzazione sufficientemente fine e ottenere una stima accurata.

Il confronto diretto tra le curve empiriche ottenute dai dati ponderati e gli *envelope* generati dalle simulazioni ha permesso una precisa identificazione dei fenomeni di aggregazione o dispersione spaziale, chiarendo le dinamiche spaziali intrinseche dei ritrovamenti archeologici a diverse scale di analisi. Infine, per facilitare una lettura efficace e immediata dei risultati, sono stati predisposti report interattivi in formato HTML, generati mediante le librerie *knitr* e *rmarkdown*. Questi documenti mostrano chiaramente le curve empiriche, le linee teoriche di riferimento e gli *envelope* di confidenza per ogni periodo e per ciascun parametro di peso analizzato, supportando così un'interpretazione chiara e una valutazione critica e approfondita dei *pattern* spaziali emersi dall'analisi.

3. Risultati

3.1 KDE in QGIS e R

Le analisi di KDE condotte in QGIS (fig. 2) rivelano come, nella fase villanoviana, i ritrovamenti archeologici si concentrino principalmente nelle aree collinari di Peccioli (Podere Ortaglia, ID 38) e Palaia (Montacchita, ID 44), con altitudini comprese tra 150 e 190 m s.l.m. In contrasto, le aree di bassa quota come Pontedera (Giuncaiola, ID 21) a 20 m s.l.m., mostrano una distribuzione più rarefatta. Durante il periodo orientalizzante, Palaia e Ponsacco (Podere S. Eugenio, ID 23) mantengono una buona densità di concentrazione, alle quali si aggiunge l'area di Terricciola dove si registra una crescita significativa e Montopoli in Val d'Arno, con particolare attenzione alla zona di Marti (160 m s.l.m.) che inizia ad emergere con una densità moderata. Nel periodo arcaico, Peccioli, Palaia e Terricciola continuano a dominare la distribuzione collinare mentre l'area di Pontedera, quella di bassa quota. Inoltre, emergono nuove aree di frequentazione nella zona di Montopoli in Val d'Arno e più a nord nella zona di Castelfranco di Sotto. Nel periodo classico si confermano le aree di Peccioli, Palaia, Terricciola e Pontedera che mantengono un'elevata densità di ritrovamenti, mentre Montopoli in Val d'Arno registra una presenza più moderata ma costante. Infine, nel periodo ellenistico, pur continuando a essere predominanti le aree collinari, si osserva un cambiamento nella distribuzione con una maggiore frammentazione e un'espansione verso le pianure, soprattutto nell'area geografica compresa tra Montopoli in Val d'Arno e Terricciola.

L'analisi spaziale realizzata in R, mediante la KDE (fig. 3), adottando un valore di sigma ottimizzato attraverso prove iterative e validato dal calcolo della funzione G a 4400 m, ha evidenziato una trasformazione progressiva e significativa nei modelli di distribuzione dei rinvenimenti.

Nel periodo villanoviano, i ritrovamenti sono maggiormente concentrati nelle aree collinari intermedie (150-170 m s.l.m.), con località come Ghizzano e Montacchita che rappresentano i poli principali. Tuttavia, c'è una presenza significativa di reperti anche nelle aree pianeggianti di Pontedera e Ponsacco (20 m s.l.m.) che mantengono in tutti i periodi una forte densità. Le altitudini più elevate, come a Parlascio (290 m s.l.m.), registrano invece una scarsa densità di ritrovamenti, indicando una minore preferenza per le aree di quota molto elevata. Durante il periodo orientalizzante, la concentrazione si mantiene stabile, con un'elevata densità nei bassopiani, ma si assiste a una crescita più marcata delle zone collinari, in particolare a Marti e Terricciola (160-170 m s.l.m.). Nel periodo arcaico, la distribuzione dei ritrovamenti si stabilizza nelle aree pianeggianti, ma si nota un rafforzamento della presenza nelle colline tra Marti, Peccioli e Terricciola (140-190 m s.l.m.). Durante il periodo classico, si osserva un ulteriore consolidamento nelle colline, con l'area tra Terricciola e Ceppato (140-170 m s.l.m.) che registra una delle più alte densità, mentre le altitudini oltre i 250 m s.l.m. rimangono scarsamente occupate. Nel periodo ellenistico, la tendenza alla crescita della densità nelle colline continua, con una riduzione della presenza nei bassopiani. Le aree principali di concentrazione si trovano a Pontedera e in tutta l'area tra Marti e Peccioli.

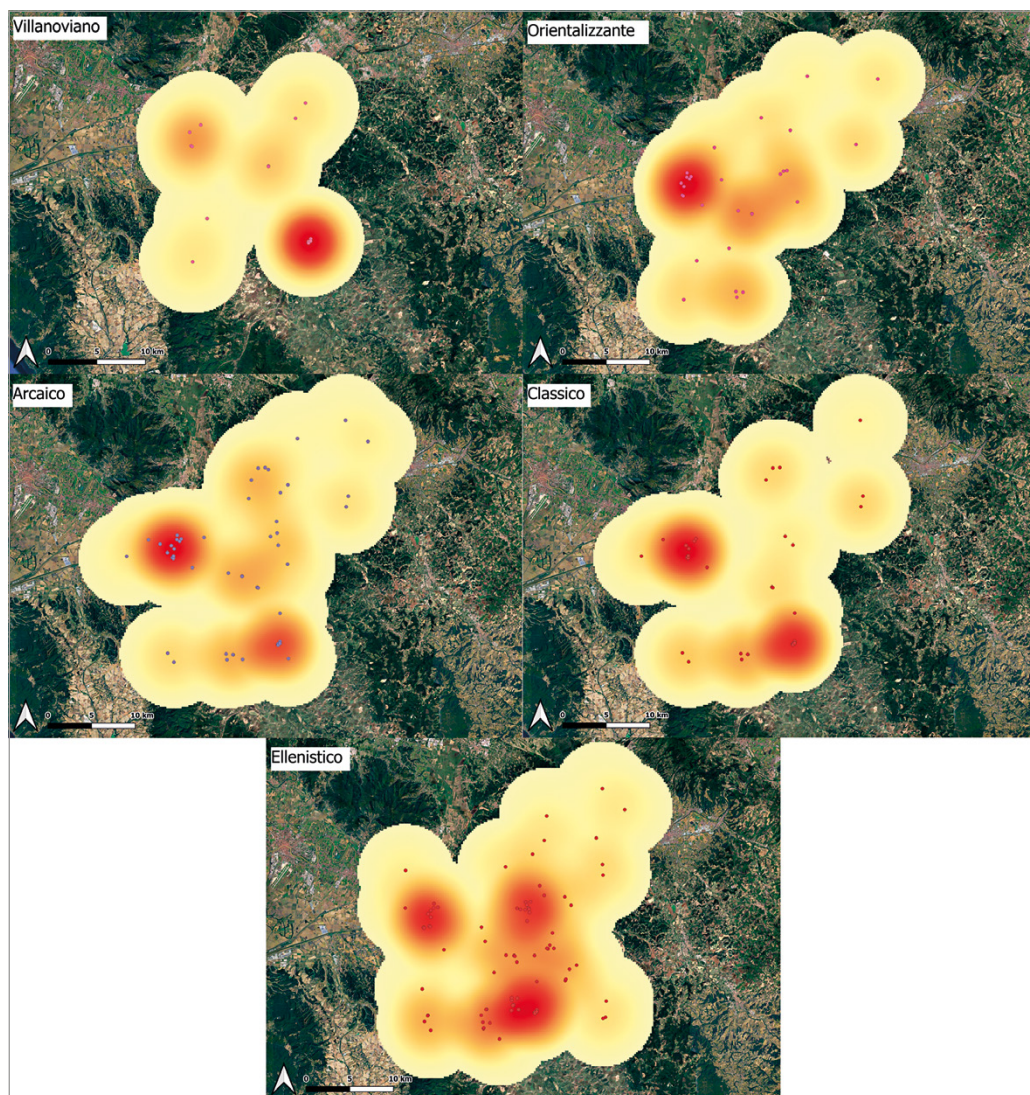


fig. 2. Analisi di *Kernel Density Estimation* (KDE) realizzata tramite QGIS, mostrando la distribuzione spaziale dei ritrovamenti archeologici suddivisi per periodi cronologici (villanoviano, orientalizzante, arcaico, classico, ellenistico).

3.2 Analisi del NNI in ambiente *R* e GIS

L'analisi spaziale dei ritrovamenti archeologici è stata approfondita mediante il calcolo del NNI, sia in ambiente GIS che tramite linguaggio *R*. I risultati delle analisi condotte in ambiente GIS sono sintetizzati nella Tabella 1 (tab. 1).

Parallelamente, l'analisi effettuata in ambiente *R* ha confermato pienamente i risultati ottenuti con QGIS (tab. 2), supportando ulteriormente la tendenza alla formazione di *cluster*.

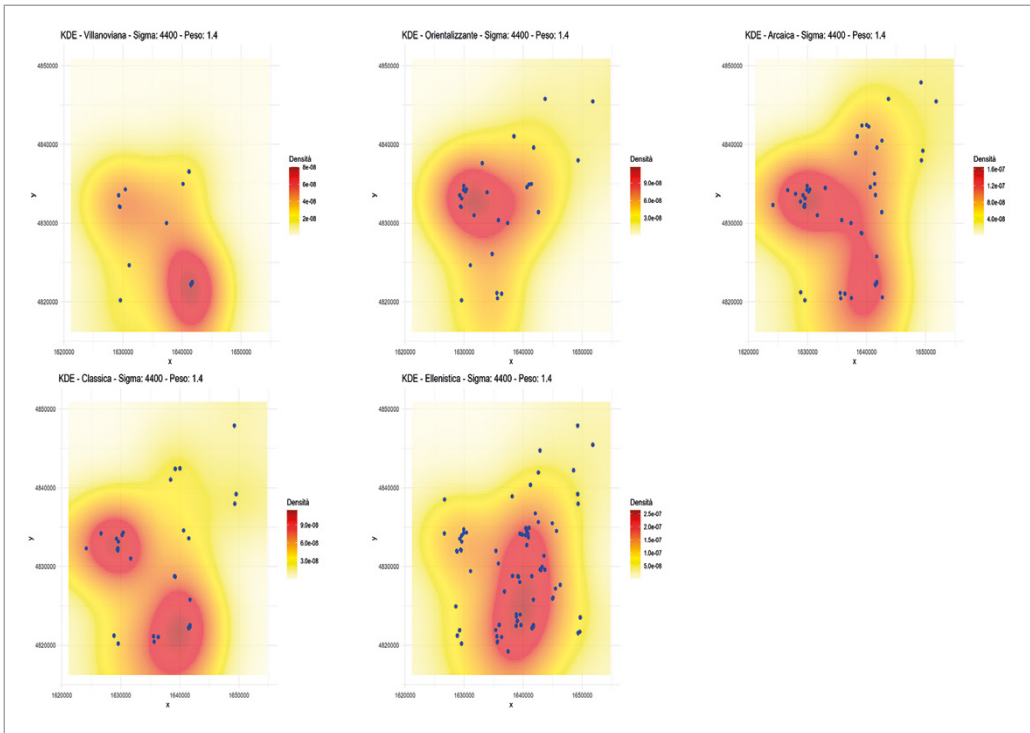


fig. 3. Analisi di *Kernel Density Estimation* (KDE) realizzata tramite R, mostrando la distribuzione spaziale dei ritrovamenti archeologici suddivisi per periodi cronologici (villanoviano, orientalizzante, arcaico, classico, ellenistico).

La forte concordanza dei risultati ottenuti dai due strumenti metodologici ne rafforza ulteriormente la solidità. In particolare, il periodo villanoviano evidenzia un *clustering* moderato e statisticamente significativo, mentre il periodo orientalizzante presenta una distribuzione quasi casuale, con un livello di aggregazione inferiore. Nei periodi arcaico e classico, invece, si osserva un'intensificazione marcata del *clustering*, mentre il periodo ellenistico mostra una graduale attenuazione dell'aggregazione.

3.3 Analisi funzioni spaziali K Ripley, G, F, J

L'analisi spaziale dei ritrovamenti archeologici è stata approfondita adottando un approccio integrato, basato sulle funzioni spaziali K di Ripley, G, F e J implementate in R. L'obiettivo principale era esplorare la distribuzione spaziale dei siti archeologici, tenendo conto del grado di affidabilità delle informazioni. Durante la fase preliminare, in particolare nell'applicazione della funzione G corredata di *envelope* ottenuti da 5000 simulazioni Monte Carlo, è emersa una soglia critica di circa 4400 m. Oltre tale distanza, la funzione G iniziava infatti a restituire valori NA, segnalando che le stime non erano più affidabili. Questo fenomeno, lungi dall'essere un mero "errore tecnico", fornisce un'informazione metodologica preziosa: i 4400 m rappresentano presumibilmente il limite ottimale per analizzare la distribuzione dei ritrovamenti in

Periodo	Numero di punti	Distanza media osservata (m)	Distanza media attesa CSR (m)	NNI	Z-Score
Villanoviano	16	1037.426	1783.6867	0.5816	-3.2015
Orientalizzante	30	1985.373	2191.3849	0.9059	-0.9850
Arcaico	56	929.279	1847.9182	0.5028	-7.1168
Classico	35	997.654	2240.0758	0.4453	-6.2772
Ellenistico	85	919.185	1455.848	0.6313	-6.5016

tab. 1. Risultati dettagliati dell’analisi *Nearest Neighbor Index* (NNI) condotta in QGIS, suddivisi per periodo.

Periodo	Numero di punti	Distanza media osservata (m)	Distanza media attesa CSR (m)	NNI
Villanoviano	16	1037.24	1783.68	0.582
Orientalizzante	30	1985.05	2191.38	0.906
Arcaico	56	929.13	1847.92	0.503
Classico	35	997.50	2240.08	0.445
Ellenistico	85	919.04	1455.85	0.631

tab. 2. Risultati dettagliati dell’analisi *Nearest Neighbor Index* (NNI) condotta in R, suddivisi per periodo storico, con comparazione dei valori di NNI per ciascun periodo.

modo statisticamente robusto. Un ulteriore e rilevante aspetto riguarda l’incremento utilizzato nel vettore di *r* per le funzioni come *Fest()*, che richiedono una discretizzazione sufficientemente fine. È stato constatato come uno *step* di 50 m risulti troppo ampio, causando una griglia eccessivamente grossolana e la comparsa di valori NA. Riducendo l’incremento a 20 m, è stato invece possibile catturare con maggiore accuratezza le variazioni locali, specialmente nelle funzioni *F* e *J*. Per quanto riguarda l’assegnazione dei pesi nel campo “Affidabilità”, i valori compresi tra 0,9 e 2 hanno mostrato il miglior equilibrio tra la capacità di distinguere correttamente i livelli di affidabilità e l’evitare distorsioni. Pesi troppo bassi avrebbero di fatto annullato la capacità di differenziare i singoli dati, mentre pesi elevati avrebbero enfatizzato in modo eccessivo un numero ristretto di punti, compromettendo la robustezza delle analisi.

Per definire un unico valore da impiegare in maniera uniforme, è stata quindi calcolata una media dei pesi più rilevanti, adottata come peso unico per l’intero *set* di funzioni. Questa scelta garantisce una coerenza metodologica nei confronti di tutte le analisi successive, evitando di sovra- o sotto- rappresentare specifici ritrovamenti e consentendo una lettura più equilibrata dei dati. Inoltre, l’impiego di 5000 simulazioni Monte Carlo per il calcolo degli *envelope* ha permesso di ottenere stime di confidenza molto più stabili rispetto alle 99 o 1000 simulazioni, consentendo di individuare variazioni anche minime con una maggiore sicurezza statistica.

I risultati delle analisi spaziali evidenziano, in tutti i periodi considerati (villanoviano, orientalizzante, arcaico, classico, ellenistico), un marcato *pattern* di *clustering*. In particolare, la funzione *K* (fig. 4) resta al di sopra della curva CSR su tutte le distanze

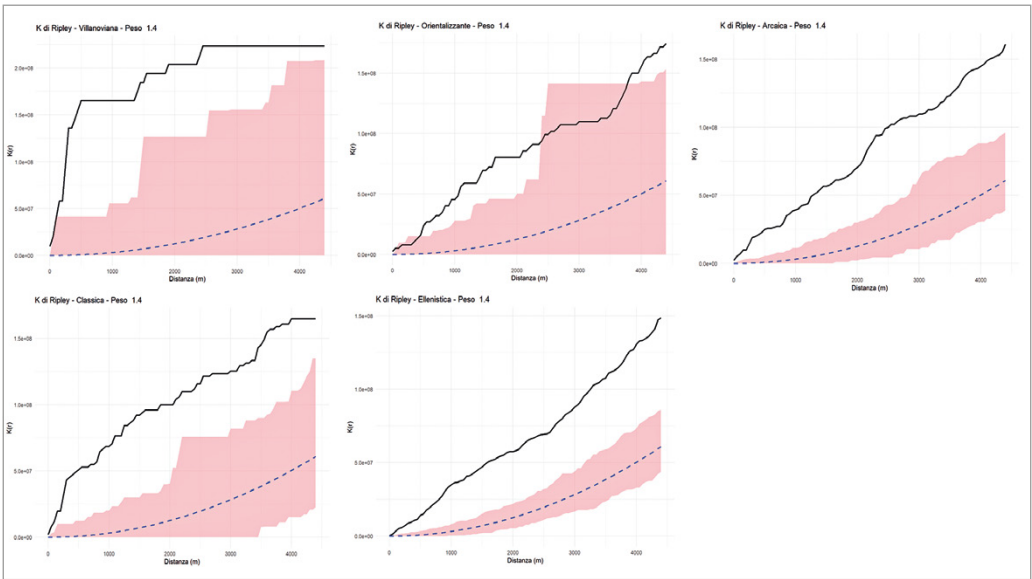


fig. 4. Visualizzazione della funzione K di Ripley per i periodi villanoviano, orientalizzante, arcaico, classico ed ellenistico, ottenuta tramite analisi in R, con assegnazione di un peso pari a 1,4 e 5000 simulazioni Monte Carlo.

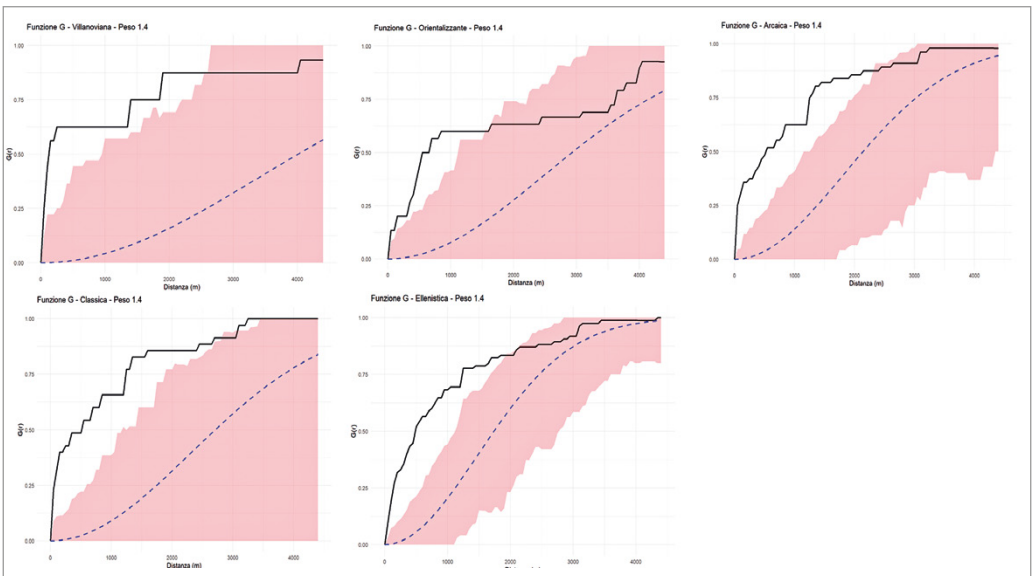


fig. 5. Visualizzazione della funzione G per i periodi villanoviano, orientalizzante, arcaico, classico ed ellenistico, ottenuta tramite analisi in R, con assegnazione di un peso pari a 1,4 e 5000 simulazioni Monte Carlo.

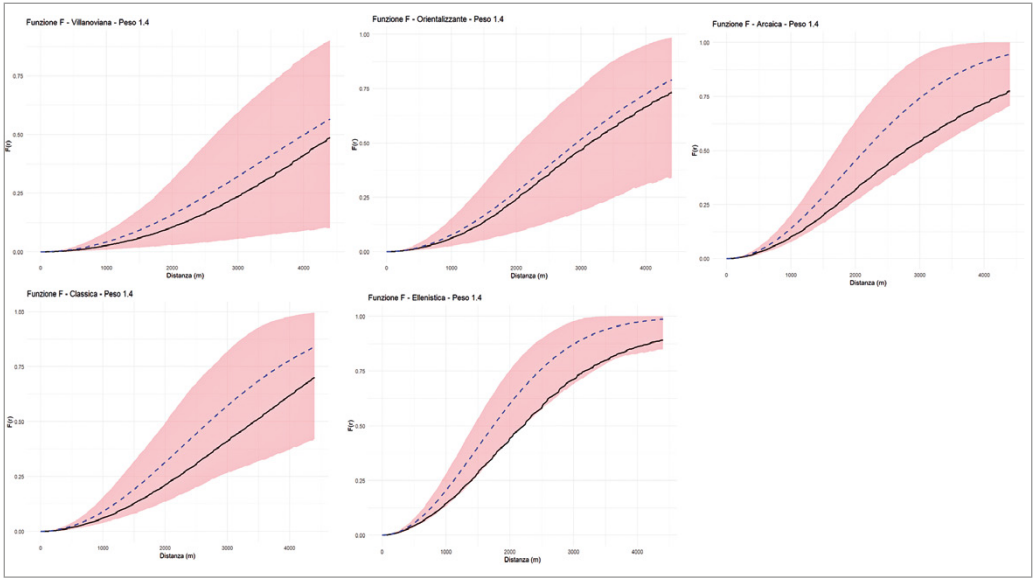


fig. 6. Visualizzazione della funzione F per i periodi villanoviano, orientalizzante, arcaico, classico ed ellenistico, ottenuta tramite analisi in R, con assegnazione di un peso pari a 1,4 e 5000 simulazioni Monte Carlo.

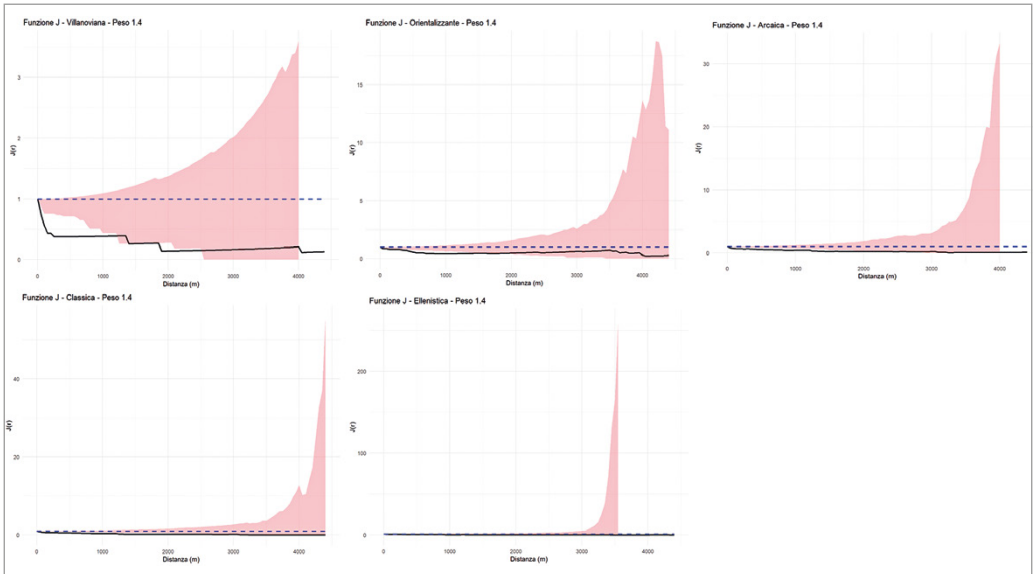


fig. 7. Visualizzazione della funzione J per i periodi villanoviano, orientalizzante, arcaico, classico ed ellenistico, ottenuta tramite analisi in R, con assegnazione di un peso pari a 1,4 e 5000 simulazioni Monte Carlo.

analizzate, confermando un'elevata densità di siti e un addensamento su scala locale e media. La funzione G (fig. 5) mostra un rapido aumento della curva, superando la curva CSR a distanze relativamente brevi e indicando che la maggior parte dei siti ha vicini molto più prossimi di quanto previsto da una distribuzione casuale, un segno di *clustering* significativo, soprattutto su scala piccola e media (fino a circa 2000 m). La funzione F (fig. 6), mantenendosi sotto la curva CSR, suggerisce che, nonostante il *clustering*, esistano ampie aree vuote lontane dai nuclei di ritrovamenti, indicando che questi tendono a concentrarsi in alcune zone specifiche. La funzione J (fig. 7), infine, rimane sotto il valore 1 per quasi tutto l'intervallo di distanze, confermando il pattern aggregato e l'assenza di una distribuzione regolare dei siti.

4. Discussione dei risultati

La presente ricerca mette in luce l'importanza cruciale della gestione e valorizzazione dei *legacy data* per una solida analisi spaziale, nonostante le sfide poste dalla natura eterogenea e spesso incompleta dei dati archeologici. La digitalizzazione e sistematizzazione dei dati provenienti da fonti bibliografiche, inizialmente privi di coordinate precise, ha richiesto un approccio metodologico rigoroso basato su tecniche avanzate di vettorializzazione e georeferenziazione. L'integrazione di strumenti GIS e analisi spaziali esplorative come la KDE, il NNI e le funzioni spaziali K di Ripley, F, G e J hanno consentito di identificare modelli di distribuzione e tendenze insediative significative nel medio Valdarno tra il periodo villanoviano e quello ellenistico.

Uno degli obiettivi principali del progetto è stato quello di trasformare un catalogo bibliografico in un DB strutturato e georeferenziato, in grado di supportare analisi spaziali dettagliate. La scelta di digitalizzare i dati mediante Microsoft Excel e successivamente integrarli in QGIS, garantendo l'interoperabilità attraverso l'utilizzo di vocabolari standardizzati (come quelli provenienti dai portali MAGOH e GNA), ha reso i dati uniformi e facilmente integrabili con ulteriori risorse digitali, facilitando aggiornamenti futuri e confronti interdisciplinari. Questa strategia ha consentito di preservare l'integrità dei dati, nonostante la presenza di problematiche inerenti alla natura dei *legacy data*, soggetti a interpretazioni e possibili alterazioni nel processo di digitalizzazione (Huggett, 2022).

Le analisi spaziali, condotte con strumenti complementari come QGIS e R, hanno fornito un quadro dettagliato della distribuzione dei ritrovamenti archeologici attraverso le diverse fasi cronologiche, suggerendo possibili dinamiche di insediamento nel medio Valdarno. L'analisi di KDE ha evidenziato una notevole variabilità nei periodi storici: nel periodo villanoviano, i ritrovamenti si concentrano principalmente in aree collinari come Peccioli (Podere Ortaglia, 150-190 m s.l.m.) e Palaia (Montacchita, 160-190 m s.l.m.), il che potrebbe indicare un insediamento strategico, probabilmente per esigenze difensive e di controllo territoriale. Nel periodo orientalizzante, si osserva un'espansione dei ritrovamenti verso nuove aree come Terricciola e Montopoli in Val d'Arno, suggerendo una crescita della densità insediativa e lo sviluppo di strutture più permanenti, che potrebbe riflettere una maggiore stabilità e intensificazione delle attività economiche e di traffici (Alberti et al., 2004, pp. 7-8). Nel periodo arcaico,

emergono nuovi siti di interesse, con attività agricole e commerciali più intense, in aree come Pineta del Maltufo, Montopoli in Val d'Arno e Castelfranco di Sotto. Tuttavia, alcuni siti sembrano essere stati abbandonati, forse a causa di fattori ecologici o altri eventi che ne hanno influito sull'abitabilità (Ciampoltrini, 2010, pp. 135-144). Nel periodo classico, la distribuzione dei ritrovamenti diventa più equilibrata tra alture e pianure fertili, con un incremento nelle attività agricole e commerciali e una maggiore attenzione al controllo delle vie fluviali, come dimostrano i ritrovamenti di anfore greco-italiche. Infine, nel periodo ellenistico, si registra un'espansione significativa dei ritrovamenti verso le aree di bassa quota, come Pontedera e Ponsacco, suggerendo un cambiamento nelle dinamiche insediative, con un'accentuata attenzione alle risorse fluviali e alle pianure fertili (Bruni, 2008, pp. 567-569; Ciampoltrini, 2014, pp. 37-40).

Il caso specifico dell'area di Pontedera rappresenta una problematica particolare, caratterizzata da un'elevata concentrazione di reperti anche nei periodi più antichi, nonostante la bassa altitudine. Ciò suggerisce l'influenza di fattori locali specifici, forse legati al controllo delle rotte fluviali o alla disponibilità di risorse idriche.

Anche l'applicazione dell'algoritmo NNI ha evidenziato una tendenza generale al *clustering* nei periodi analizzati, con valori inferiori a 1. Questo comportamento, confermato sia in QGIS che in *R*, indica che i ritrovamenti non sono distribuiti casualmente, ma si concentrano in aree specifiche, suggerendo insediamenti strategicamente organizzati, in particolare nei periodi arcaico e classico.

Dinamica confermata dall'analisi integrata delle funzioni K, G, F, e J dei vari periodi storici che ha rivelato un pattern di *clustering* evidente, variabile in base alle distanze e al periodo considerato. Nel periodo villanoviano, il *clustering* è particolarmente marcato a distanze inferiori ai 2000 m, mentre durante l'orientalizzante, i siti tendono a raggrupparsi con distanze tra i vicini spesso inferiori ai 1000 m, pur mostrando un eccesso di densità fino a 3000-4000 m. Nel periodo arcaico, il *pattern* di *clustering* persiste, con una concentrazione maggiore tra i 2000 e i 2500 m. Nel periodo classico, la distribuzione continua a mostrare un raggruppamento compatto, con distanze medie contenute tra i siti. Infine, nel periodo ellenistico, il fenomeno si mantiene forte su scala locale (fino a circa 2000 m) e si estende anche a distanze maggiori, con una densità superiore rispetto a un modello casuale.

In sintesi, le quattro funzioni analizzate confermano un *pattern* di *clustering* costante in tutti i periodi. Le funzioni G e K risultano superiori alla curva CSR, evidenziando distanze più brevi tra i siti e una maggiore densità locale rispetto a una distribuzione casuale. La funzione J, con valori inferiori a 1, suggerisce una distribuzione aggregata piuttosto che regolare, mentre la funzione F mostra valori sotto la curva CSR, indicando la presenza di ampie aree prive di insediamenti e confermando la concentrazione dei siti in nuclei distinti. L'analisi delle distanze mostra che già entro i primi 1000-2000 m i siti sono significativamente più vicini rispetto a una distribuzione casuale, con il *clustering* che si estende fino a circa 3000-4000 m, pur con differenze tra i vari periodi.

Nonostante i risultati ottenuti offrano una visione dettagliata della distribuzione spaziale nel medio Valdarno, emergono alcune criticità. La mancanza di coordinate storiche precise ha richiesto metodologie di georeferenziazione che, sebbene efficaci, introducono margini di errore interpretativo. Ulteriori sviluppi potrebbero perfezionare tali tecniche, integrando dati provenienti da altre fonti storiche e cartografiche.

Inoltre, l'aggiornamento continuo del DB con nuove scoperte, insieme all'utilizzo di tecnologie digitali avanzate, risulta essenziale per migliorare ulteriormente la veridicità delle analisi spaziali. L'adozione di modelli statistici più avanzati, inclusi approcci di *machine learning* per l'identificazione di *pattern*, potrebbe fornire nuove chiavi di lettura delle dinamiche insediative del medio Valdarno.

5. Conclusioni

Questo studio ha permesso di fornire una rappresentazione grafica e spaziale dei dati raccolti, restituendo un possibile quadro dell'evoluzione della distribuzione dei ritrovamenti archeologici nell'area del medio Valdarno, attraverso un approccio metodologico integrato che unisce tecniche GIS con analisi statistico-spaziali avanzate. L'applicazione delle metodologie di KDE, NNI e le funzioni spaziali (K di Ripley, G, F, J) ha confermato un marcato *pattern* di *clustering* dei ritrovamenti, evidenziando variazioni significative nelle distanze tra i siti e nelle aree di maggiore concentrazione nei diversi periodi storici.

I risultati hanno rivelato un progressivo consolidamento e spostamento dei ritrovamenti: inizialmente concentrati in aree collinari durante il periodo villanoviano, si espandono gradualmente verso le pianure nei periodi successivi, con una densità crescente in epoca ellenistica. L'analisi delle distanze ha inoltre suggerito che, in tutti i periodi, i ritrovamenti risultano essere più ravvicinati rispetto a una distribuzione casuale, indicando una possibile organizzazione territoriale strategica influenzata da fattori geografici e ambientali. Un dato di particolare interesse emerge dai siti di Pontedera e Ponsacco, che mostrano una concentrazione elevata di ritrovamenti a bassa altitudine anche nei periodi più antichi. Questo fenomeno potrebbe suggerire dinamiche specifiche, probabilmente di natura economica, sociale o ambientale, che meritano ulteriori approfondimenti.

In conclusione, sebbene l'uso dei *legacy data* presenti alcune limitazioni, come incertezze derivanti dalla mancanza di coordinate precise e potenziali errori interpretativi (§1), i processi di digitalizzazione, georeferenziazione e analisi hanno consentito di valorizzare efficacemente le informazioni disponibili. Questo ha permesso di ottenere risultati significativi nello studio della distribuzione dei ritrovamenti archeologici nel medio Valdarno.

Per il futuro, sarà fondamentale continuare ad aggiornare il DB con nuove scoperte e migliorare le metodologie analitiche. Inoltre, l'integrazione del DB in un sistema web-GIS interattivo permetterebbe una più ampia diffusione dei dati, facilitando l'accesso e la consultazione da parte di studiosi e ricercatori, e favorendo nuove collaborazioni per approfondire ulteriormente il tema del popolamento dell'area.

Bibliografia

- Alberti, A., Baldassari, M., Bisio, E., & Ciampoltrini, G. (2004). *Dai villaggi etruschi ai castelli medievali: Palaia e il suo territorio nei secoli*. Bandecchi & Vivaldi.
- Anichini, F., Gattiglia, G., & Saponara, A. R. (2023). MAGOH: Un nuovo strumento per la gestione e la consultazione dei dati archeologici del Nord della Toscana. *Archeologia e Calcolatori*, 34(2), 277-296.

- Baddeley, A., Rubak, E., & Turner, R. (2016). *Spatial point patterns: Methodology and applications with R* (Vol. 1). CRC press.
- Basile, S., & Campus, A. (2023). Integrating Point Pattern Analysis and Logistic Regression approaches for exploring the settlement pattern of the Versilia and Garfagnana mountains in Roman times. *Archeologia e Calcolatori*, 34(2), 87-104.
- Bruni, S. (2008). Località Le Serre, Podere Ortaglia: Scavi nel santuario etrusco. *Notiziario della Soprintendenza per i Beni Archeologici della Toscana*, 3(2007), 496-711.
- Casarotto, A., Pelgrom, J., & Stek, T. D. (2019). A systematic GIS-based analysis of settlement developments in the landscape of Venusia in the Hellenistic-Roman period. *Archaeological and Anthropological Sciences*, 11, 735-753.
- Ciampoltrini, G. (2010). Edilizia rurale tra Valdarno e Valle del Serchio: la colonizzazione etrusca tra VI e V secolo a.C. e le deduzioni coloniali d'età tardorepubblicana. In M. Bentz & Ch. Reusser (eds.), *Etruskisch-italische und römisch-republikanische Häuser* (pp. 135-144). Reichert Verlag.
- Ciampoltrini, G. (2014). *Gli etruschi della bassa Valdera tra Pisa e Volterra. Prolegomeni all'edizione dello scavo della Giuncaiola di Pontedera* (2011-2012). Tipografia La Grafica Pisana.
- Ciampoltrini, G., & Grassini, F. (eds.). (2011). *Gli etruschi e le vie d'acqua. L'insediamento della Granchiaia fra Montopoli in Val d'Arno e Marti*. Edizioni ETS.
- Clark, P. J., & Evans, F. C. (1954). Distance to Nearest Neighbor as a Measure of Spatial Relationships in Populations. *Ecology*, 35(4), 445-453. <https://doi.org/10.2307/1931034>
- Diggle, P. J. (2013). *Statistical analysis of spatial and spatio-temporal point patterns*. CRC press.
- Fabiani, F., & Gattiglia, G. (2012). La struttura informatica di archiviazione. In Anichini, F. Fabiani, G. Gattiglia, & M. L. Gualandi (eds.). *MAPPA. Metodologie applicate alla predittività del potenziale archeologico. Volume I* (pp. 41-71). Nuova Cultura.
- Gatrell, A. C., Bailey, T. C., Diggle, P. J., & Rowlingson, B. S. (1996). Spatial point pattern analysis and its application in geographical epidemiology. *Transactions of the Institute of British Geographers*, 21(4), 256-274.
- Hu, H. (2025). Spatial synergy between cultural heritage and metro networks: A case study of distribution patterns and value assessment in Beijing. *Sustainability*, 17(4), 1666.
- Huggett, J. (2022). Data legacies, epistemic anxieties, and digital imaginaries in archaeology. *Digital*, 2(2), 267-295.
- Illian, J., Penttinen, A., Stoyan, H., & Stoyan, D. (2008). *Statistical analysis and modelling of spatial point patterns*. John Wiley & Sons.
- Kempf, M., & Günther, G. (2023). Point pattern and spatial analyses using archaeological and environmental data: A case study from the Neolithic Carpathian Basin. *Journal of Archaeological Science: Reports*, 47, 103747.
- Moore, D.S., McCabe, G.P., & Craig, B.A. (2009). *Introduction to the practice of statistics* (Vol. 4). W. H. Freeman.
- Nakoinz O., & Knitter D. (2018). *Modelling human behaviour in landscapes: Basic concepts and modelling elements*. Springer.
- Orton, C. (2004). Point pattern analysis revisited. *Archeologia e Calcolatori*, 15, 299-315.
- Ripley, B. D. (2005). *Spatial statistics*. John Wiley & Sons.
- Squarcini Berti, F. (2022). *Il popolamento del medio Valdarno tra l'Età del Ferro e l'età ellenistica*. [Tesi di laurea non pubblicata]. Università di Pisa.
- Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with S* (4th ed.). Springer.
- Wickham, H. (2006). An introduction to ggplot: An implementation of the grammar of graphics in R. *Statistics*, 1, 1-8.

Alexandra Teodor*

* Teaching Assistant, PhD – UAUM, Bucharest.

MORPHOLOGICAL ANALYSIS DATA MODEL FOR ROMAN SETTLEMENTS

Abstract: The paper presents a methodology for documenting the morphology of archaeological urban settlements, developed on the analysis of the cities from a marginal Roman province, *Scythia* (modern Dobrudja). Just like specialists in ceramic and numismatic have standard procedures in documenting their objects of interest, so should the specialists that study ancient cities – even if there may not be yet a defining term for this specialization. A data model dedicated to the physical configuration of urban settlements was adapted to document fifteen relevant sites

in the historical region mentioned above. Its last version is presented here, along with the dataset collecting published archaeological evidence on the urban structures of ancient *Tomis* – located in the historical centre of Constanța, Romania. The advantages, disadvantages and limitations of this method are also pointed out, including recommendations for technical improvement.

Keywords: urban morphology, urban analysis, data model, methodology, urban archaeology.

1. Introduction

The dataset and a good part of the paper is part of my doctoral research project, albeit adapted. Entitled *Urban and military configurations in the province of Scythia*¹, it was finalized a decade ago and remained unpublished. The starting goal of the research was to collect and assemble the archaeological records relevant for the morphology and the transformations of the Roman cities in Dobrudja² during the (roughly) three centuries of Late Antiquity. Many historical and archaeological syntheses had already described them in various breadths³, while the aspects regarding their morphology

¹ Drafted in Romanian, “Configurațiile urbane și militare din provincia Scythia” (Teodor, 2014a). Available online in full extent, including the fifteen site files, of which one is presented here in English.

² Ancient *Scythia*, also referred to as *Scythia Minor*, today corresponds to a territory split between Romania and Bulgaria, by the Black Sea coast.

³ A selection of titles, with a focus on the ones published in English or French: Gajewska, 1974; Velkov, 1977; Biernacka-Lubańska, 1982; Suceveanu & Barnea, 1991; Zahariade, 2006.

and evolution were approached in a stereotype manner, by highlighting the regular urban pattern and high quality architecture of the early phases, that gradually disintegrated in the later phases, typically correlated exclusively to the historical timeline of the province. There are also frequent deviations towards military, administrative, religious, or other sorts of typologies regarding cities, which are rarely correlated to their physical configuration. These approaches only sketch indirect perspective on the built environment. Except for (apparently) relevant examples of the urban and architectural realm, the actual analysis and data correlation on this thematic area was extremely superficial – where not completely absent.

A methodology that implied multiple and interleaved phases was pursued, in order to compensate for the shortcomings mentioned above. Briefly put, the relevant data⁴ was collected and assembled on a predefined structure (the Data Model, further abbreviated *DM*⁵), including a synthetic presentation of the existing interpretation(s) (and my interpretation, if I had reached a different one). This was applied for fifteen archaeological sites, in volume 2 (text) and 3 (illustration) of the thesis. The same DM structured Volume 1 (synthesis), which could only be assembled after the site files were completed.

Although the technical solution proposed is not built on the latest state of art (a relational database integrated to a GIS platform), it could be fairly adapted to one. Likewise, the information in the site files is already processed and structured to (largely) allow distinct associations between geometrical features and corresponding data.

The initial purpose was to undergo an urban analysis; it is indeed largely an urban level survey. However, a minimal evaluation of the layouts had to be pursued to confirm or adjust accordingly the functional interpretation for the built structures; this is why the plans were measured and described (knowing that prior to a systematic description, a visual evaluation can be superficial). Likewise, certain preoccupations regarding typical discourse on Late Antiquity (e.g. the impact of Christianity, the decay of building quality etc.) also pushed towards an architectural analysis – without covering it on all the possible facets. This architectural level approach was consistently time consuming and weighed a good proportion of the site files' lengths.

This paper presents the structure (DM) that I considered relevant for thoroughly describing an archaeological urban settlement. It was built on a theoretical layout and adapted on the fly, while processing the documentation. The dataset attached contains an editable version of the DM, and an example for the most important city in the chosen area of study. Among all, the site file for ancient *Tomis* (modern Constanța) is also the most relevant for urban archaeology.

From where I see it today, urban archaeology can be approached from at least two directions, which are in fact complementary. One could be named “the bottom-up approach”, corresponding to the method presented here, or similar others: the relevant

⁴ Most of it was published material within archaeological reports, studies, or monographs (see section 2.5), that usually remains dissipated, redundant, uncorrelated, and thus sometimes lacking update or even conflicting.

⁵ In this paper, the *Data Model* is the structure proposed for the documentation of an urban settlement, while the *site file* is the same structure filled with the relevant data, for a certain site (dataset, *I-3-TOMIS*).

archaeological data for an urban settlement or area is collected, organized, and then analysed on various levels. The other can be seen as “the top-down approach”, where today’s urban configuration is first classified depending on the characteristics of the urban fabric, then analysed comparatively to cartographic sources and to the known archaeological structures (here is where the first approach can come into play), in order to determine the potential for archaeological remains or traces⁶. The first direction inventories and summarizes the existing data, the other has a significant predictive component, therefore the best possible approach for urban archaeology would be to integrate both.

2. The Data Model (DM)⁷

2.1 Urban analysis in archaeology

On a theoretical level, the analysis of the urban structures exploits all the relevant available information regarding the environment, the physical elements and the relations between all of them⁸. The major workflow of this process is ideally circular in its progression, and theoretically consists of the following main phases: (1) the documentation (collecting and/or presenting the rough data); (2) the interpretation and its outcomes (typologies, definitions, characteristics etc.) on different scales (correlations, analogies etc.); and (3) the critical evaluation of both the available data and its interpretations. The latter normally occurs after the first two phases, and it is in fact a trigger for their reactivation (being, indeed, a sort of verification), by also integrating new data if the case (repeat phase 1) (subsequently) adapting or significantly changing the interpretation and the corresponding outcomes (repeat phase 2). The cyclic character of this general workflow⁹ is in fact necessary to valorise both the existing and the new data; conversely, as time passes, all the data accumulated becomes increasingly difficult to integrate.

All the phases are extremely important, as each has its role in the analysis workflow described. However, with the experience of the mentioned doctoral project in mind, I want to emphasize the role of the first phase – the documentation, i.e. the collection of the rough data, or the input data in the process. If this phase is faulty, it is understood that the outcomes of all the following phases (or the output) are highly arguable. Moreover, since obviously neither all these major phases, nor many and various segments of research cannot be accomplished by a single individual, a collective effort is required on data management so that the whole data, but especially the input data, can be continuously reused (or re-integrated to new sets of data).

⁶ Teodor, 2023. This study was in fact fuelled by the situation of *Tomis*, after an earlier one (Teodor, 2014b, 122 *sqq.*) revealed potentially common elements between the ancient and the present urban configuration.

⁷ This part is an adapted translation of chapter 2.3 in the thesis manuscript (Teodor, 2014a).

⁸ On the relations between the environment, the structures and people, with the various approaches for their interpretation, see Johnson, 2002, *passim*.

⁹ On the cyclic character of the interpretation process in archaeology, see Johnson, 2002, 340.

The situation is quite far from the ideal with the bulk of archaeological data available for Dobrudja. Briefly put, the input data is not only frequently random and inconsistent¹⁰, but sometimes also corrupted by mixing interpretation with the rough data, in a manner that makes them difficult to distinguish¹¹. The first category of problems comes from the lack of a standardized procedure for collecting data about built structures; it is difficult to understand why such methodologies are used for pottery, coins, bones, and earth stratigraphy, but not for buildings – at least in Romanian archaeology. The corrupted data is rarer, and it is simply due to a lack of structure (also) in its presentation. The methodology proposed here can only address the clutter at best, while the corrupted data is unfortunately compromised for good.

2.2 On methodology: the city as a system

The data available in the various archaeological sources is even more puzzling than the archaeological puzzle itself; it is either repetitive, variously interpreted, lacunar, vague and so on. So before trying to solve the main urban archaeology puzzle, the rough data puzzle had to be settled. Furthermore, as expected, the quantity of data varied from one site to another. Therefore, if the sites with a brief history of excavations (thus, less information) could easily be managed without a thoroughly structured layout, this was not the case for the sites with extensive excavations. At the same time, to enable a clean and clear analysis for all the relevant case studies, they had to be somehow “equalized” or brought to a common denominator. An inventory of the data available (the classical catalogue) seemed to be the solution, but how about the structure of the inventory? To be useful for morphological urban analysis, it had to be tailored on the city morphology itself.

The methodological approach used here was not inspired by any precedent in the historical and/or archaeological literature¹², but by the most basic morphological principles of the historical/traditional cities. The city was reduced to (or interpreted as) a system composed from built elements (the infrastructure and the main types of buildings), and the relations between them (how they relate and determine each other's configuration). A common structure (DM) for collecting data on the considered elements was conceived. The main relations between the elements were approached in a separate analysis, which merged the data from all the fifteen case studies¹³; this part is not covered here.

¹⁰ Most of the archaeological reports consulted for this project are full of such examples, but I prefer to only offer a theoretical example: when presenting the walls of a house in a narrative manner, one could easily miss, here and there, a feature or two out of some basic data (e.g.: conventional name; maximum preserved width, height, length; material(s); building technique; preservation state). Such inconsistencies can compromise statistics and implicitly can influence the data interpretation.

¹¹ E.g., Sâmpetru, 1994 is a narrative description of the excavated buildings, with a focus on their hypothetical functional interpretation; if one would want to simply extract the rough data, it would first be a tricky exercise of phrase morphology.

¹² I couldn't identify one in due time for the doctoral research, nor had I found something relevant in the meantime. From my perspective, this area between urban archaeology and urban morphology is lacking both theoretical framework and practice.

¹³ Teodor, 2014a, chapters 10.1-3.

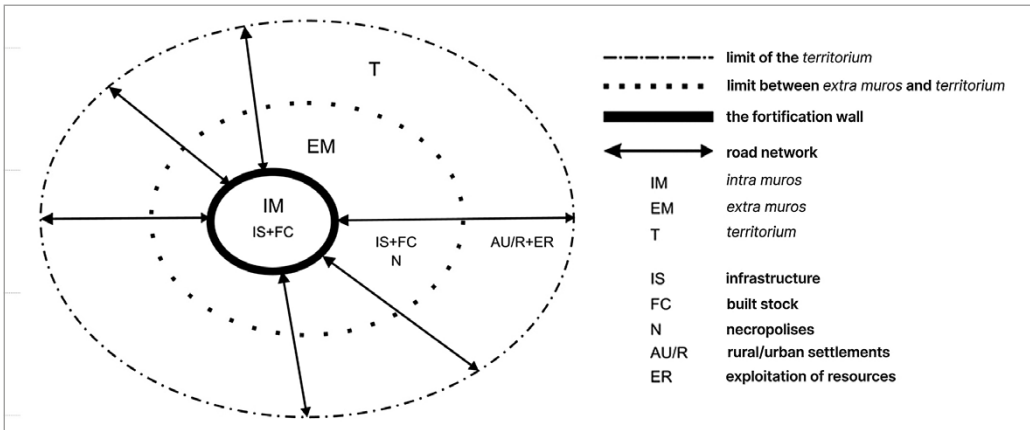


fig. 1. The schematic interpretation of the major elements contained by the Roman city (*civitas*).

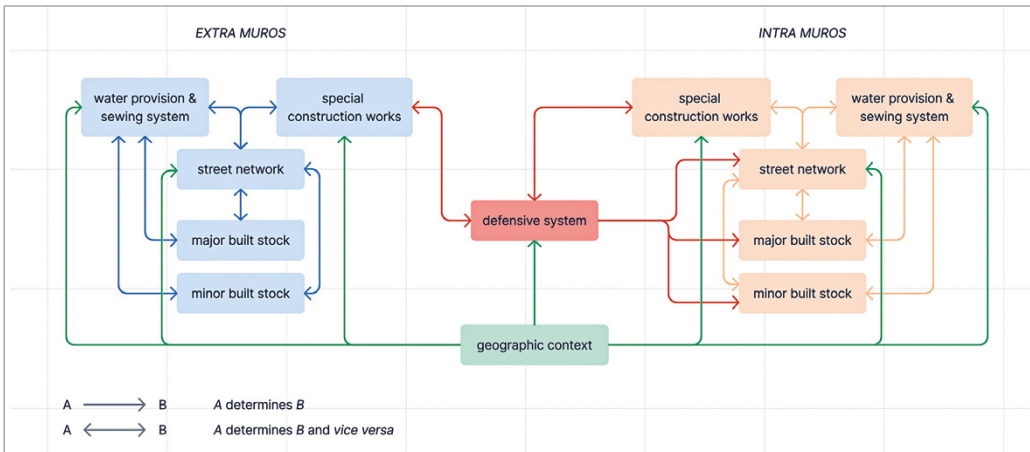


fig. 2. The intuitive relations between the elements of the city mentioned in *Figure 1* and the general influence of the external factors.

The structure of the DM began with a question: *What is an ancient city*¹⁴, from a *morphological point of view*? It is an ensemble of interrelated elements, as illustrated and explained below. **Fig. 1** is a simplified spatial distribution scheme of the main elements, and **fig. 2** highlights the main¹⁵ system of relations between the same elements. These schemes were the skeleton and articulations of the developed method.

¹⁴ The *city* itself is perhaps one of the most debatable and debated concepts in historiography. See an authoritative, theoretical approach on the Roman city for the same period at Ward-Perkins, 2008.

¹⁵ It is only a simplification meant to help the understanding of the basic dynamic for a city; it would perhaps be suitable in the scenario of a predefined city layout within a pre-existing *territorium*. Obviously, the relations could be slightly different if the predefined city would have to adjust to a pre-existing urban settlement, with its own topographic landmarks.

Most of the elements were considered from the start – such as the fortification¹⁶ and the corresponding *intra* and *extra muros*, or the *territorium*, the street network etc. However, the more detailed structure for the street network, or the architectural programmes of the buildings, were designed based on the collected material – see section 2.4.1. Hence, the current structure of the DM was gradually tailored during the entire documentation process. Any new case study could improve this structure.

For this study, the main elements of the city¹⁷ are (from the larger scale towards the detailed):

- the hinterland (or *territorium*), which contains rural (and eventually other urban) settlements and the basic elements of economic exploitation (soil and underground resources, water etc.) for the hinterland and its urban centre.
- the infrastructure of the *territorium* (roads and the associated infrastructure, water provision systems etc.).
- the *extra muros* of the urban centre, with its own infrastructure and buildings.
- the limit between the *extra muros* and the *intra muros*; the city walls – when they exist, playing a defining physical element in both the urban landscape and the hinterland.
- the *intra muros*, with its own infrastructure and buildings.

Obviously, not all these elements are sharply separated. In fact, some are quite continuous from the territory straight to *intra muros* (where the main streets are nothing but extensions of the roads, or *vice versa*, while the aqueducts may cross most of these elements), but for methodological purposes it is useful to consider them as such. Notably, the relevance of the *territorium* is very pale in the given framework, compared to the relevance of the *extra muros*, and especially *intra muros* elements. However, I considered that the descriptive DM should approach the city as a general object of study, rather than a mere reflection of the particular interest in this project – since it could, theoretically, expand in other directions.

How do these elements work together, and how do they determine (each) other? **fig. 2** schematically answers this question. The purpose of the question and answer is to increase the awareness regarding relations frequently overlooked, due to the lack of a systematic approach. The proposed relations are intuitive, based on the overall, albeit simplified understanding of the topic.

The descriptive DM was not designed to include the other dimensions of the city, such as the economic, juridic or social/anthropological components; for the area discussed, these aspects are to be (or have been) studied by scholars with suitable background and preoccupations¹⁸.

¹⁶ For the area and period discussed, the fortification is a defining feature of the city, unlike earlier periods and more central areas of the Roman Empire.

¹⁷ Notably, an important urban element that is missing in these schemes is the ensemble of parcels, by which the land was divided; except for the obvious limits between the sidewalks and the buildings, or between the ensembles of buildings themselves, there is no other archaeological evidence for these delimitations – nor were they ever pursued in the archaeological investigations that I have been reading about so far; normally, such limits free of buildings would have been delimited by fences.

¹⁸ Aparaschivei, 2010 (juridic & administration); Soficaru, 2011 (population).

2.3 The site files: text + drawings

This theoretical understanding of the city – as a system of interrelated elements – was used to assemble the relevant data available in the selected sources into what I named here “the site files.” The DM (a template site file structure) was designed accordingly with the schemes illustrated above, common for all the selected sites – regardless of their corresponding level of investigation. Hence, for the sites where what is known gets close to nothing, some fields in the site files remained empty. I consider this approach has two great methodological advantages:

Despite the unesthetic appearance of incompleteness, putting the available data in such a disclosure will in fact emphasize what needs to be explored in the future, for all the analysed sites, and especially for those less investigated – from the perspective of urban morphology, at least.

The structure of the site file allows for an easy correlation between the elements of the same site but also facilitates analytical parallels between similar elements of different sites (this is how the site files were used in the synthetic part of the doctoral project¹⁹).

The survey drawings of the built structures are extremely important in our analysis. In fact, urban morphology could not exist in the absence of survey drawings; regardless of how detailed and thorough a built structure is described in words, in the absence of its basic spatial coordinates (position relative to other identifiable landmarks, orientation, geometrical shape etc.) the documentation becomes null for urban morphology analysis. This is why the site file annex of the doctoral project (Volume 2) was doubled by a volume of drawings (Volume 3) – excerpts of the digital (vectorial) drawings, respectively all the necessary frames in order to (largely) describe each site and its built components; thus, similarly to the written parts, the sites with a larger documentation had significantly more plans than the ones with less data. In the dataset attached to this paper, besides the *.pdf excerpts, one can also find the vectorial drawing²⁰ for the case study of *Tomis* (Constanța).

Therefore, the site files are composed of two complementary parts (which means they are to be consulted alongside to fully understand the described situations): the text and the drawings. The latter were composed by integrating all the relevant drawings available into one large vectorial data set, organized in multiple layers. This

¹⁹ Based on the data collected in the site files, Chapter 6 of the first volume presents the configuration of the settlements in a sequence of longitudinal sections, summarizing the data on each main urban element, for all the analysed sites (as presented below in section 2.4.1); similarly, chapters 8 and 9 present brief data on the territories and, as a special topic thoroughly pursued, some conclusions about building materials and techniques, including *spolia*.

²⁰ What could not be integrated, due to (possible) copyright issues, are the digital excerpts of the plans used as support for the vectorial drawing. However, the vector data was kept on layers named according to the sources, therefore their paternity is largely traceable; the names of the sources usually correspond to the bibliographic abbreviations, albeit with some unintentional exceptions which are due to my own inconsistencies.

was a particularly arduous work, which frequently meant obtaining the undistorted digital versions of the published drawings (when not already available in digital format, usually as *.pdfs), integrating each digital drawing in the general site plan by scaling and positioning it based on reference points; most of the drawings were also vectorized in order to be assembled with the similar data from other sources into a uniform plan representation²¹. Most of the elements identified on the plan were labelled – such as the fortification walls (curtains, gates and towers), streets and buildings – in order to easily correlate the data presented in the text with the drawings. When available, the names or labels already assigned in the source literature were also presented.

In this endeavour, although the interest was in the greater picture (the cities, their functioning, and their transformation), the routine of previously parsing the relevant elements was considered mandatory for a comprehensive perspective. Although this was not a sophisticated demarche (with exceptions), it was the most time consuming.

2.4 The content of the written site files

In the *General Data* (DM, section 2.1²²), after introducing the relevant data and the known issues regarding the site's identification (1.1-1.2), the site file structure continues with the synthetic description of the natural environment (1.3)²³, a brief history of the archaeological research (1.4), and the key points in the ancient history of the site (1.5), following the foundation, the major evolution phases²⁴, and the role within the Roman province.

Nevertheless, the built structures remained the focus of the collected data. The most consistent part of all the site files is section 2.2, *The built environment*. The highly ramified structure of this part was a continuous challenge because the purpose was to reach a standard presentation of each built element at the urban scale. Usually, the built structures are presented in a freestyle description, depending on the preoccupations and efforts of the authors; they frequently include *some* measurements, chronology, relations with other elements, and interpretations all together. For example, an excavation report of a section crossing the fortification would present the city wall, the adjacent buildings, and the corresponding street in a narrative manner, within a compact paragraph. My approach was to identify each separable urbanistic element (for example, a coherent building ensemble, like a basilica, or a residential unit), and to present exclusively the corresponding data. Following the theoretic example above, in the site file the data from the same excavation report will be separated and distributed to the defensive system (2.2), to the street network (2.3.1.2), and to the

²¹ This was rather the intention; it was not possible to always achieve it where multiple overlaps between different data sets occurred. Some were hidden for the print version (to allow clarity), but the digital file contains them all.

²² In this part of the paper (2.4), “section” refers to the parts of the DM (dataset, *0-DataModel*).

²³ When relevant data regarding the ancient environment is available, brief conclusions and implications for the urban settlement are also presented. This was the case, for example, with *Tomis*, *Histria* and *Halmyris*.

²⁴ The major phases are largely based on the general chronological periodization of the province, with the known particularities for each site.

buildings (2.3.2, the corresponding program). Conventionally, considering the subject of the project, the delimitation between *intra* and *extra muros* was considered to be the Late Roman city wall²⁵; this is only a limitation of the traditional text and drawing method, while a relational database GIS could correlate data relative to multiple precincts, thus extending the complexity of the analysis.

Another relevant example of the data distribution used in this documentation method is the one of the water provisions. While a traditional approach would present this topic as a unit, may it also be rigorously structured, here it is deconstructed into multiple sections:

- in section 1.3.2.4, where all the known water sources are presented – rivers, phreatic waters etc., local or remote, regardless of their presence (*territorium*, *intra* or *extra muros*); this forces the researcher to an evaluation of all the theoretical possibilities and to the correlation to the other relevant subsections in the same dataset, e.g. the local context of the geographical setting, including geological aspects;
- subsequently, in the corresponding subsections dedicated to water provision remains, for *intra muros* (2.3.1.3), *extra muros* (2.4.1.3), and *territorium* (3.4).

All the circulations are approached similarly; they are divided, conventionally (and according to **fig. 1**), between *intra muros* streets, *extra muros* streets, and roads in the *territorium* – even if it is a continuous circulation. This indicates, among others, the archaeological coverage on different thematic (not only areas), helps focus selectively on certain areas, and helps highlight the relations (including comparative) between urban elements or areas. For instance, how many ramifications does the street network have *intra muros* compared to *extra muros*; what is the density and distribution of production between certain areas; are there exceptions to established rules, like funerary evidence inside the city walls? Is there a significant difference in the diversity of the building types between *intra* and *extra muros*? The answers to all these questions and to many others are possible to approach once the data is distributed in the proposed manner. Certainly, at least some of these answers can also be provided by the spatial data (here, the drawings), but each criterion means a different conventional representation; outside relational databases integrated to a GIS environment, these types of reports are extremely laborious. This site file system is, therefore, a useful preliminary phase for a comprehensive and flexible database structure.

Among the multiple advantages of the component / deconstructed approach – thus, by deliberately ignoring the connections between them – is that they can be easily moved from a category to another. For example, if at some point in the future one concludes that the functional or chronological interpretation of a building was mistaken, the component can be easily moved to the proper category. By doing this, nothing else needs to be changed in the site file – perhaps only in the analytical part concerning relations, statistics etc., if there is one (outside the site file, as a separate

²⁵ Moreover, sometimes the multiple phases within the Late Roman Period also mean different extents in the surface; in these cases, I considered the widest known delimitation. It is also the case of *Tomis*, see dataset.

demarche); conversely, if the data would have been integrated to an elaborated text also containing relational interpretations, everything would have required careful revision.

The main numbering of the DM sections is conceived to be uniform throughout all the site files. This facilitates longitudinal thematic analyses; for example, if one is only interested in the sewerage system, instead of consulting the entire site file(s) for possible mentions – like archaeological reports often constrain us to – in this site files only sections 2.3.1.4 (*intra muros*) and 2.4.1.4 (*extra muros*) are relevant.

If the general structure of the site file did not raise too many issues, the multiple types of built structures and especially their (sometimes) problematic interpretation did require special attention. Another such element was the street network. They are both detailed in the following subsection.

As briefly mentioned, what is missing from these data sets, implicitly from the resulting analysis, is the data regarding the population that lived in these settlements. Besides being a problematic subject itself²⁶, an indirect approach was preferred, by presenting relevant data which was possible to obtain from the collected drawings. Manual measurements on the vectorised data²⁷ (many of which, if not all, would be outdated in a GIS technology) were inserted into (largely) all the descriptions of the major architectural remains. The analysis of a building's functionality, as well as the comparative studies between buildings or architectural programs often rely on measurements, among other criteria. This is why it was considered useful to provide, as much as possible, measured surfaces for the major architecture, as well as the minimum, maximum and medium surfaces for minor urban fabric (largely residential, as briefly explained below). Even if our perception of space (and especially regarding its qualities) is inherently subjective, the size of these buildings can be relevant, given the common human scale.

The chronological segmentation of the data is another convention that needs to be mentioned. This was in fact tailored for the subject of the thesis, but it could be an approach of more general interest. The periods considered here were divided into three large categories (the Greek Period, the Early Roman Period, and the Late Roman Period), each one with the subcategories relevant for the entire region (while indicating the correlation with the published stratigraphy for each site²⁸). These common categories are crucial for the synthetic, longitudinal analyses focused on shorter periods of time, and especially on the evolution of the urban fabric – even though the latter was not yet properly addressed²⁹.

²⁶ On the difficulties related to population estimations see, for example, Wilson, 2011; Crouch, 2003, 14-5.

²⁷ Despite my intention and the efforts to work on a georeferenced base, these measurements may still contain errors, due to the painstakingly scaling and georeferencing procedure applied to all the integrated drawings, which cannot be extremely precise. As an observation, my measurements were often different from the numbers provided by the archaeological reports. Hence, depending on the purpose of one's research, it is best to consider a minimal verification before directly using the data provided in these site files.

²⁸ Obviously, in a relational database the correlation between the stratigraphic data of each site and the conventional chronological intervals should be properly addressed.

²⁹ Unfortunately, the evolution of the urban fabric is perhaps one of the most compromised directions of analysis in the studied region, due to the way buildings are generally interpreted, and implicitly the poor quality of the collected data. Basically, except for the larger structures (like fortifications, basilicas, *thermae* etc.), there is a common misconception that the minor urban fabric disappears with each destruction – and

One could notice another missing outcome: the three-dimensional restitutions. This was considered quite far from the purpose (understanding urban fabric configuration), and premature³⁰.

2.4.1 The classification of the urban fabric: conventions and limitations

The main challenges in structuring the data were encountered regarding the street network and the buildings. The solutions presented below are reflected in the sub-structure of the site files – especially the ones documenting complex and/or extended archaeological contexts.

The study of Alan Kaiser³¹ was the starting point towards establishing the methods to classify both streets and buildings. Even if his methods were not applicable as such, as explained below, the main criteria were adapted here to the particularities of the archaeological sites chosen for study.

Regarding the street network, Kaiser proposed a system which can be applied to any (well known) city delimited by fortification walls, by using four criteria: (1) the depth (“how many streets and plazas one must pass through in order to reach a chosen street within a city from the edge of that city”³²); (2) the distance between the streets and the main *forum/agora*; (3) the number of intersections along a circulation axe, and (4) the permission or interdiction for heavy traffic (vehicles). He applied this system to archaeological sites that have been extensively uncovered, like *Pompeii* and *Ostia*. The depth (1) was also used here, with the adjustments detailed below; however, the last three criteria aren’t applicable in Dobrudja, because: (2) the *forum* is frequently unknown; (3) the entire profile of a street is rarely documented; and (4) except for the obvious traces of wheels which may have been preserved on the streets’ pavements, no one has ever addressed the accessibility for vehicles in these cities, especially beyond the main streets – so there is simply no data³³. Nevertheless, in a synthetic approach, all the four criteria are each a refined version of establishing hierarchy – thus, different criteria based hierarchy: accessibility from outside the city, accessibility from the centre of the city, rank within the overall network (both pedestrian and vehicles), and accessibility for vehicles – hence, contributing to the rank of economic potential. Therefore, focusing the classification on a rough sense of hierarchy alone seems reasonable.

A significant aspect to consider when evaluating relevant criteria for classification is the variation of the streets themselves in longer periods of time. For example, the main street of a city may suffer significant transformations along the centuries: what

there are many destructions documented during the studied period. Added to that is the fact that archaeological sections are often limited to the superior layers, therefore the data is rarely completely collected for the entire lifespan in the sector. Building archaeology as a discipline has not yet earned its share in the archaeological practice in Dobrudja.

³⁰ While two key directions are missing: a detailed analysis of every major architecture, and of the minor urban fabric. Schematic or phantasmal restitutions cannot be considered scientific, and such endeavours are already too many.

³¹ Kaiser, 2011, especially chapter 2, “Defining and Analyzing Street Networks in the Archaeological Record”.

³² Hillier and Hanson’s concept, as explained by Kaiser, 2011, 53.

³³ Such pragmatic aspects of urban life are rarely a trigger for archaeological research in the local practice.

used to be a wide and colonnaded street with covered sidewalks, gradually became a narrow street with irregular profile, due to the multiple houses that encroached it³⁴. The implication of such evolutions is that depending on the criteria, the category can vary in time for the same item (following the example above, the street profile would be a fragile criterion). Therefore, the ideal criterion for classification (especially in a less dynamic system, like the traditional one presented here) should be as constant as possible – like the position in space.

The common denominator for most of the analysed sites was that the fortifications were largely known, thus the relation with the main gates³⁵ could more or less be fairly established; not so much for the (real, historical) distance, but rather for the *directness* (or depth, as defined above): how many times you have to change directions (on the shortest path) in order to get from the gate to a certain street – thus, the ramification of the route between the two types of elements. The following system was applied for both naming³⁶ (or renaming³⁷), and the systematization of the available data:

- level 0 streets are the main axes that start from, or cross through the main gates.
- level 1 streets are all the ones deriving from level 0 streets; the ones that start from, or cross through a secondary gate; and the *intra muros* perimeter street (successor of the classical *intervallum*)³⁸.
- level 2 streets are all the ones deriving from level 1 streets, and they are usually in the depth of the urban fabric.
- etc.³⁹

³⁴ This was a typical process in Late Antiquity; the scheme of Sauvaget explains it visually, see Ward-Perkins, 2008, 383, fig. 3. In Dobrudja it is best documented at *Tropaeum Traiani*, along what is called *Via Principalis*.

³⁵ For consistency across all the fifteen sites, the “main gate” also had to be defined. From a functional point of view, a main gate is considered here to be the place where the fortification is intersected by a road from the *territorium*, respectively where the entrance inside the fortified area is allowed by a special design; normally, the size of the entrance is proportional with the importance of the road. Secondly, since the gate implies a physical breach in the fortification line, the access areas are usually treated with special care in terms of defensive architecture. Last, but not least, the most important gates could have also carried a representation role (like other major building programmes); thus, the defensive architecture of a gate can also have a monumental setting and/or expression, with or without decorative elements. These three criteria (basic functionality, defensive emphasis, and monumentality) were used to conventionally establish which are the main gates in our case studies.

³⁶ Especially required for the correlation of the written data with the drawings; I find referrals such as “to the left/right”, “to the south/north” frequently confusing for a reader. Names and/or codes are much more suitable, including for any GIS/database technology.

³⁷ Renaming streets was not for the sake of changing their consecrated names (in fact, I strived to maintain them as alternative names), merely for the (intended) uniformity in approach, and for a sense of orientation. Any reader, experimented or not with a site, would thus be able to identify with relative ease, based on the structure of the code, where a street is located. Notably, in AutoCAD and in .pdf readers the text is searchable.

³⁸ These streets not only derive from the main streets, but they are also the first ones parallel (thus, enabling access) to the fortification walls.

³⁹ Obviously, the list can continue infinitely, but that is not very likely. No such category was necessary for the analysed sites, although for some of them it is plausible when and if more significant data will be known (e.g. *Tômis* – not so much for the size, but for the conformation as peninsula, where the urban fabric spreads towards its end, far beyond the city walls).

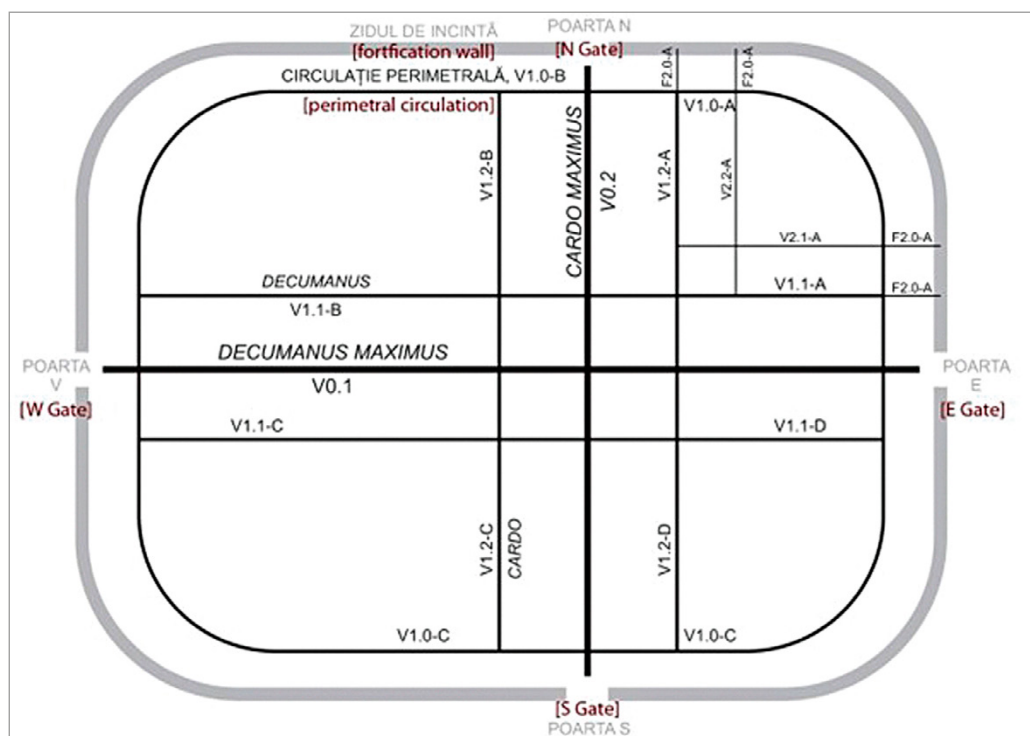


fig. 3. The scheme of the conventional names used in the analysis of the street network. V = Via; F = Fundula; V1.1-B = the hierarchy level; V1.1-B = orientation: 0 for the perimetral circulation and the one derived from it; 1 for W-E; 2 for N-S; V1.1-B = the name of the sector.

The base system used for the names of the streets is presented in fig. 3. It was conceived on the street network configuration of *Tropaeum Traiani* because this site is one of the most extensively excavated, also having a reminiscence of a classical layout. The system was then loosely adapted to the other sites⁴⁰. For orientation purposes, the sites' traditional toponymy (e.g., the names of the gates or archaeological sectors) were used in the composition of the name code (see *Histria* or *Tropaeum Traiani*).

Another difficulty may come when considering distinct phases of the city fortifications – if there are multiple such expansions or reductions. In such cases, the largest extent in the period of interest was considered (Late Antiquity, for this project). This is a limitation of the traditional written site file, but it could be overcome in a GIS & relational database system – although with significant complications.

⁴⁰ Notably, the system could not be applied for *Tomis* (also presented in this dataset) – among other sites – precisely because it was not possible to establish the relation between the gates and the small fragments of known streets. The street names used in this case were derived from the main roads known to have connected the city to the *territorium*, the ones used in the archaeological sources, or other variants considered suitable.

As a general principle, the best method for standardization should fit as many cases as possible, therefore it is probably fair to state that although the method presented here may fail to highlight certain refinements within the functional relations of the urban elements, it does allow unitary approach for a wider type of archaeological sites (especially the extinct ones), compared to Kaiser's method – which could, nevertheless, parallel it and yield interesting comparative analysis for the more thoroughly investigated sites. Conversely, the method presented here (as well as Kaiser's) doesn't seem to satisfactorily cover the present day urban archaeological sites, for which unstandardized area names is perhaps still the most pragmatic approach; however, relative hierarchy could still be used for wider areas, where the most prominent street – in breadth, for example – can be attributed to level 0 (or to whatever level can be approximated at the urban level).

On buildings, Kaiser works with a functional classification adapted to the Roman cities and their archaeological character. He sets eight categories for buildings: administrative, commercial, entertainment, health, production, religious and residential, also reserving a category for unidentified functions⁴¹ – which is obviously quite necessary for archaeological sites. Notably, this approach is adapted to the author's focus on streets, thus considering buildings as peripheral elements associated with the streets. In our research, streets and buildings are elements of equal importance – being two of the main urban elements, as previously stated.

In a broader and theoretical view, the built stock can be perceived visually (both in plan, but also in a three dimensional restitution) in two types of urban fabric: the first type is composed of noticeable, large-sized buildings, most of which had (presumably) public functions; and the second is composed of small-sized buildings that form together the urban background, and are frequently residential units, largely to be associated with (presumably) private functions. Although their use may have been mixt (small commercial, or industrial functions integrated into the residential units would be the most common example throughout the Roman world), the residential and private character was considered predominant.

The classification proposed here combines the mentioned criteria (dimensional, juridical, and functional) into the following categories and subcategories:

- the “major”⁴² built stock, with the programmes grouped in:
 - (1) administrative and representation: civilian basilicas, *curia* etc.
 - (2) religious: ensembles, pagan temples, Christian basilicas.
 - (3) entertainment, recreation, hygiene, and health⁴³: *stadia*, theatres, amphitheatres, baths, hospitals etc.
 - (4) production, storage, and commerce: *factoria*, *horrea*, *macella* etc.
 - (5) uncertain (or unidentified) function. This category was used for the buildings or ensembles with typical features of public buildings (large dimensions and

⁴¹ Kaiser, 2011, 59 *sqq.* and tab. 2.1.

⁴² This term was used as opposed to the “minor”, see the next note.

⁴³ The category could have been split into “entertainment and recreation” and “hygiene and health”, but their overall small number on each site made this separation useless.

specific building techniques), where the attributed function is highly debatable, or stated as uncertain by the archaeologists. Buildings or ensembles attested by literary or numismatic sources, yet unidentified *in situ*, are also mentioned here⁴⁴.

- the “minor”⁴⁵ built stock: the ensemble of the private buildings, which consists of houses with residential use, or mixt functions, combining the residential with small commerce, or production activities.

Besides the categories presented above, a special one was added, due to the historical context of the studied province: the military programmes. Obviously, in a military settlement the functional variations are similar (albeit reduced in variety) to the ones of a city: buildings can have a private (e.g. the barracks of the soldiers) or common character (e.g. the baths); and can be strictly utilitarian (e.g. *horrea*), or representative (e.g. *principia*). However, since there are not many buildings or ensembles explicitly attributed to a military function in the studied region, no further ramifications were used for this section. It is also true that this aspect could complicate furthermore the entire classification because some settlements were initially purely military and later evolved into mixt or predominantly civilian settlements. These are but nuances that should be clarified for the purpose of each research.

The common structure for buildings covers a general presentation, the description of the plan, data on the building materials and techniques, and chronology. All these aspects theoretically go far beyond urban analysis, but they were included for the following reasons: the description of the plan is useful to confirm (or at least consider as possible) the general interpretation regarding the functionality and chronology, highly relevant in the overall urban picture; the building materials and techniques, as well as the planimetry and functional aspects, were considered to be very important in relation to the wider topic of transformations during the Late Antiquity – a very sensitive topic in the recent historiography. For the same reason, a special section was added to the Christian basilicas, regarding the location relative to the precinct and the orientation, because these are two significant criteria for the analysis on the urban impact of Christianity – also subscribed to the previously mentioned topic.

2.5 The sources

Amongst the two main types of sources that are directly relevant for an archaeological site, published and unpublished materials (archival, reports, manuscripts etc.), the focus was on the former – especially due to accessibility. The consulted literature was published before 2012–2014. Although I tried to cover as much as possible, in order to have consistent and relevant data, the documentation is not exhaustive. The

⁴⁴ It was not a systematic inventory, but rather an occasional one – if such information was encountered, it was noted.

⁴⁵ Referring to buildings that can be considered as (cultural) heritage, Françoise Choay defines the “minor architecture” as “private non-monumental buildings, frequently built without an architect” (my translation) – Choay, 1999: 10; although the perspective is different, it is precisely the sense intended here. The term is suggestive for both the size of the buildings, but also for their background character taken as a whole.

main type of published literature were the excavation reports (*CCA*), frequently having the status of “preliminary”, followed by articles and studies in the most prominent local archaeological journals (*Pontica*, *Peuce*, *Dacia*, *SCIVA*, *MCA*, and *CA*). The monographs are not numerous for the analysed sites – and are no longer a practical and suitable approach, technically speaking, for documenting archaeological sites.

The references to the sources within the written part of the site files can be seen as unusual, as a result of two principles that were pursued: first, to avoid repetitions – this is why the sources are sometimes presented immediately after a section title, thus they conventionally cover the entire section; second, to highlight particular information which may have been presented by a certain source, and not necessarily by others (conversely, many times the same information is repeated in multiple sources). Keeping track of all the sources was difficult, especially due to the chosen method for the data distribution, explained above. I also admit it was impossible to verify all the site file citations after they were written, hence errors can be expected. From my perspective, this was an academic research experiment than a formal academic product; the latter should be in the responsibility of the archaeological teams.

As for the drawings, the sources are recorded in two variants: a list for the drawings integrated for each archaeological site⁴⁶, and in the names of the CAD layers.

3. Closing remark

The paper presents a methodology – possibly the first – to fully document a Roman settlement from the perspective of urban configuration. It relies on two main elements that assemble *the site file*. First, the classical *written sheet*, adaptable to added content and structured so that it could be easily converted into a relational database. Second, the unavoidably necessary *drawings*, which need to be thoroughly *correlated to the written part*. The drawings are presented in a multi-layered CAD environment that allows for infinite overlays and significant analyses. All of these are compatible with GIS, which will hopefully be the next level approach of this methodology, to further prove its potential.

Acknowledgements

*I am thankful to the editors for sending me the 2024 call for publication, as I was previously unaware of this journal. Publishing editable datasets is not only the future of research, but rather a necessity long awaited, in response to multiple types of redundant operations – many of which I also had to endure, like endless vectorization and manually copying data from one part to another. I had no publication plan in mind during my PhD research; the purpose at that time was only to collect data and see what can be done with it. After successfully defending it, the publication really turned to be a problem, partly due to the considerable extent of the processed data. After years of considering various scenarios, I decided to publish it as grey literature. Even so, the *.pdf data is hardly reusable, while the editable formats simply uploaded online would not have sufficed for also*

⁴⁶ Teodor, 2014a, vol. 3, 201 *sqq.*, available online.

protecting my authorship. Fortunately, thanks to this format promoted by ArcheoLogica Data, I can consider publishing my work in full and editable extents.

I also want to express my gratitude to the reviewers, who generously encouraged my work and helped me improve the comprehension of this text.

Bibliographic abbreviations⁴⁷

- Aparaschivei, D. (2010) – *Orașele romane de la Dunărea Inferioară. Secolele I-III p. Chr.* [The Roman Cities on the Lower Danube. 1st-3rd c. CE] București, Editura Academiei Române.
- Biernacka-Lubańska, M. (1982) – *The Roman and Early-Byzantine fortifications of Lower Moesia and Northern Thrace.* Wrocław, Polish Academy of Sciences.
- Choay, F. (1999) – *L'allégorie du patrimoine.* Seuil.
- Crouch, D. P. (2003) – *Geology and Settlement: Greco-Roman Patterns.* Oxford-New York, Oxford University Press.
- Gajewska, H. (1974) – *Topographie des fortifications romaines en Dobroudja.* Wrocław, Zakład Narodowy im. Ossolińskich.
- Johnson, M. (2002) – Studying Structures. In G. Barker (ed.) *Companion Encyclopedia of Archaeology*, Vol. 1-2 (pp. 310-343). Routledge.
- Kaiser, A. (2011) – *Roman Urban Street Networks.* New York-London, Routledge.
- Sâmpetru, M. (1994) – *Orașe și cetăți romane târzii la Dunărea de Jos* [Late Roman cities on the Lower Danube]. București, Institutul Român de Tracologie.
- Soficaru, A. D. (2011) – *Populația provinciei Scythia în perioada romano-bizantină (sf. sec. III-inc. sec. VII)* [The population of province Scythia in the Roman-Byzantine period, late 3rd-early 7th c. CE]. Iași, Editura Universității Alexandru Ioan Cuza.
- Suceveanu, A. & Barnea, A. (1991) – *La Dobroudja Romaine.* București, Editura Enciclopedică.
- Teodor, A. (2023) – Antiquity in use in urban contexts: predictive analysis for urban archaeology. *New Europe College Yearbook*, Ștefan Odobleja Program 2022-2023, 125-179. Available online [Nov. 21st, 2024].
- (2014a) – *Configurațiile urbane și militare din provincia Scythia* [Urban and military configurations in the province of Scythia]. PhD diss. “Ion Mincu” University of Architecture and Urban Planning. Available online [Nov. 21st, 2024].
- (2014b) – The Roman defensive systems of Tomis. Some issues in the light of the current knowledge. *Revista Doctoranzilor în Istorie Veche și Arheologie (ReDIVA) // The Postgraduate Journal of Ancient History and Archaeology (ReDIVA)*, 2, 92-146. Available online [Nov. 21st, 2024].
- Velkov, V. (1977) – *Cities in Thrace and Dacia in Late Antiquity. Studies and Materials.* Amsterdam, Adolf M. Hakkert.
- Ward-Perkins, B. (2008) – The cities. In A. Cameron & P. Garnsey (eds.), *The Cambridge Ancient History. The Late Empire, A.D. 337-425*, vol. 13 (pp. 371-410). Cambridge University Press.
- Wilson, A. (2011) – City Sizes and Urbanization in the Roman Empire. In A. Bowman & A. Wilson. (eds.), 2011, *Settlement, Urbanization, and Population* (pp. 161-195). Oxford-New York, Oxford University Press.
- Zahariade, M. (2006) – *Scythia Minor. A History of a Later Roman Province (284-681).* Amsterdam, Adolf M. Hakkert.

⁴⁷ This list only reflects the aspects discussed in the paper. For an extended bibliography on the urban settlements in Dobrudja, and the connected framework on Roman cities, see *BIBLIOGRAFIE.doc* in dataset.

Salvatore Vitale*

* University of Pisa (salvatore.vitale@unipi.it).

FIFTEEN YEARS IN THE CLOUD AND 3500 YEARS IN ONE CLICK: A CONTEXTUAL SUMMARY OF KOAN PREHISTORIC AND PROTOHISTORIC OCCUPATIONAL SEQUENCES

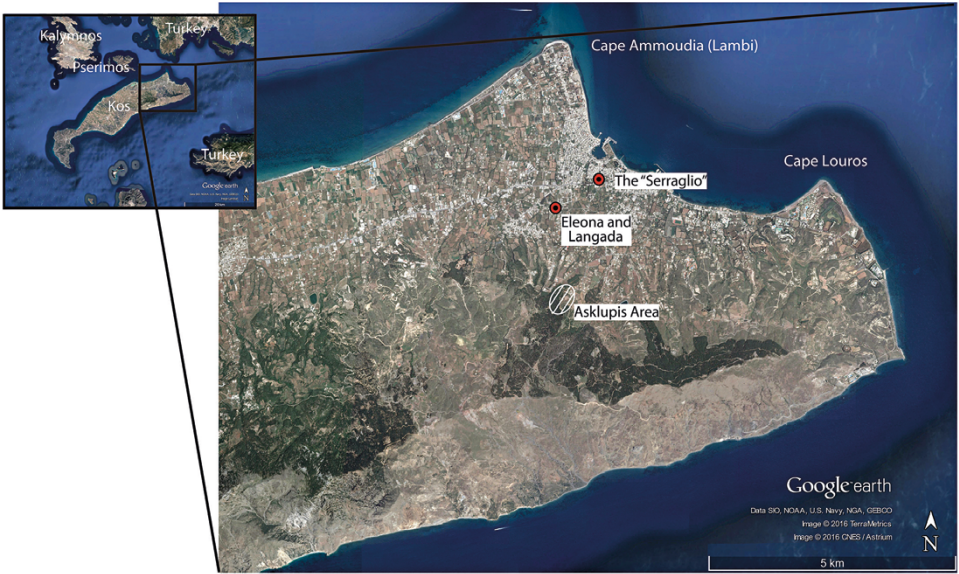
Abstract: This article presents for the first time a full contextual summary of Koan prehistoric and protohistoric occupational sequences, based on the results of the “Serraglio, Eleona, and Langada Archaeological Project” (SELAP). SELAP’s considered time span ranges from the local Final Neolithic 1 up until the end of the Late Protogeometric phase, approximately encompassing 3500 years. In addition to providing a synopsis of Koan sequences in their wider contextual and stratigraphic settings, the goal of this contribution is also to present the project’s baseline dataset to the wider academic community. While incorporating information from more recent archaeological research, SELAP’s work is primarily based on legacy data from L. Morricone’s excavations and Hope

Simpson and Lazenby’s survey, respectively carried out on Kos from 1935 to 1946 and from 1967 to 1968. SELAP’s proposed chronological sequences rely on the project’s holistic theoretical approach to periodization, which is fully disclosed and discussed in this article. SELAP’s results demonstrate that, when biases and limitations are critically addressed, legacy data can still be relevant for our current understanding of ancient human communities.

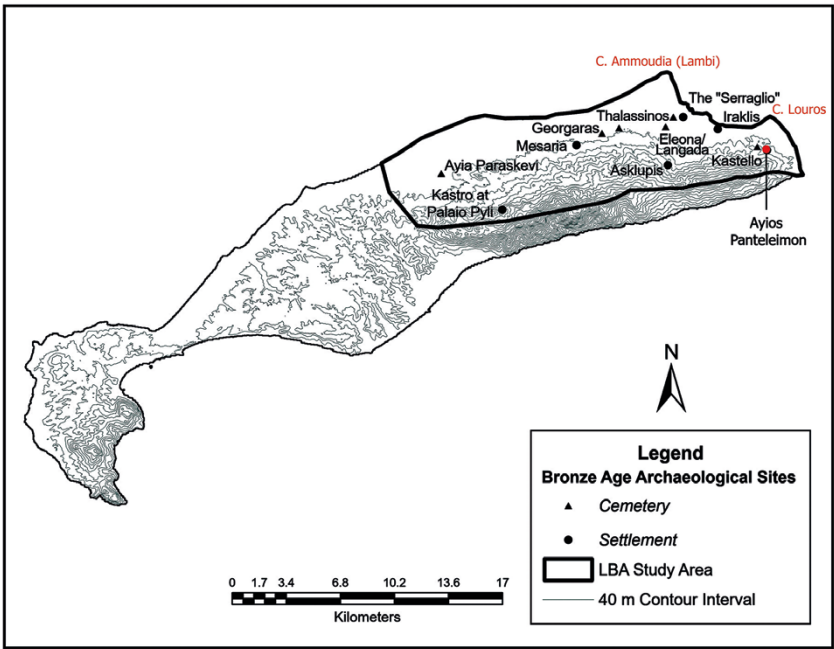
Keywords: Occupational and chronological sequences; Contextual analysis of legacy data; Theory and methods of archaeological periodization; Prehistory and protohistory of the Aegean; Southeast Aegean-Southwest Coastal Anatolian Region (SASCAR).

This article presents for the first time in full a contextual summary of Koan prehistoric and protohistoric occupational sequences based on the results of the “Serraglio, Eleona, and Langada Archaeological Project” (SELAP; for previous summaries of SELAP’s work, see Vitale, 2012; Vitale et al., 2017). SELAP’s considered time span encompasses approximately 3500 years, framed between the local Final Neolithic (FN) 1 and the end of the Late Protogeometric (LPG) phase (circa 4500 to 900 B.C.E.)¹.

¹ SELAP is a multidisciplinary research endeavor under the scientific auspices of the Italian Archaeological School at Athens. SELAP’s broader research scope is to provide new information on the socio-cultural developments that occurred on northeast Kos and the wider southeast Aegean from the FN 1 up to the end of



a



b

fig. 1. Maps of northeast Kos including the main sites and areas under SEALP’s study, with the addition of the settlement of Ayios Panteleimon from KASP’s investigations (a: base map from Google Earth adapted by C. McNamee, S. Vitale, & T. Marketou; b: C. McNamee & S. Vitale).

Since 2009, through a diverse international team of scholars and students, SELAP has studied a rich array of finds deriving from early investigations on northeast Kos, especially from (but not limited to) the sites of the Asklopis, the “Serraglio”, Eleona, and Langada (fig. 1). In addition to offering a synopsis of Koan sequences in their broader contextual and stratigraphic settings, the goal of this contribution is also to present the project’s primary dataset to the wider academic community.

The subjects of this article are discussed within six main sections. The first one outlines SELAP’s research background, providing summaries of the history of excavations and research at the four main sites mentioned above. The second section examines the problematic character of the dataset and illustrates SELAP’s methodology, focusing on the project’s approach to periodization and data storage strategies. The third, fourth, and fifth sections present SELAP’s results on Koan occupational and stratigraphic sequences, with details on the various types of contexts and associated finds used to establish the local chronological framework. The six and final section proposes some concluding remarks on the broader methodological and theoretical implications of SELAP’s approach to legacy data and research strategies.

1. Research Background

This section outlines the history of prehistoric and protohistoric research at the Asklopis, the “Serraglio”, Eleona, and Langada from the middle of the 5th millennium to the end of 10th century B.C.E. (fig. 1). The evidence is presented in chronological order, based on the foundation dates of these sites: FN 1 for the Asklopis; Early Bronze Age (EBA) 3 for the “Serraglio”; Late Bronze Age (LBA) II for Eleona; and Late Helladic (LH) IIIA2 for Langada. The chronological range indicated in the titles of Sub-Sections 1.1-1.3, as well as in other sub-sections of this paper, does not take into account any human activity that may have occurred at the targeted sites after the end of the LPG. The occurrence of occupational gaps at the Asklopis, especially between the EBA 3 and the Middle Bronze Age (MBA), as well as during shorter LBA and Early Iron Age (EIA) time spans, is thoroughly discussed below, in Sub-Section 3.1. All tabs. presented in this paper can be found in the Data Repository (DR) section (Folder 1, File 1_a).

the LPG phase. In addition to occupational sequences, that form the main subject of this contribution, the project’s research focus is concentrated on the following four subjects: landscape analysis, cultural identities, political trajectories, and funerary practices. To investigate these complex and multifaceted research questions in a methodological coherent fashion, SELAP implemented a composite theoretical approach (Vitale et al., 2022a; Vitale, 2023a, pp. 33-35; Vitale et al., 2023; Nani et al., forthcoming) using a diverse array of interpretative lenses, including, among others: mobility (Mokrišová, 2016, with previous bibliography), acculturation (Guarnaccia & Hausmann-Stabile, 2016, with previous bibliography), cultural entanglements (Hodder, 2012; Stockhammer, 2012), cultural fusion (Kramer, 2019), and social agency (Bourdieu, 1977; Giddens, 1993; Dornan, 2002, with previous bibliography).

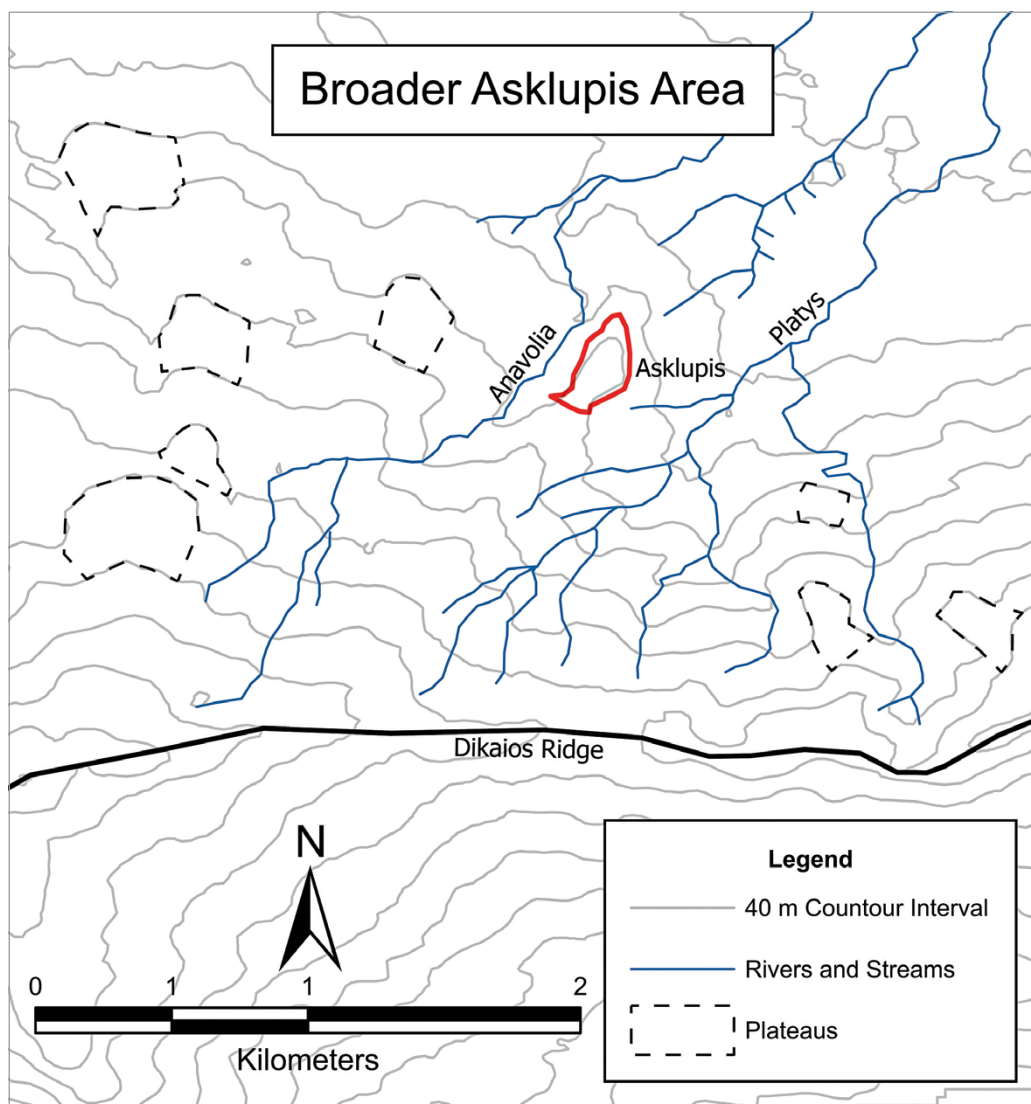


fig. 2. Significant landscape features characterizing the broader Asklopis area (C. McNamee & S. Vitale).

1.1 The Asklopis: FN 1 to LPG (with possible gaps)

The Asklopis was originally identified in the spring of 1943 by G. Lazzara (figs. 1-2). Following Lazzara's discovery, rescue excavations at the site were carried out from May 8th to May 12th of the same year by L. Morricone (Morricone, 1975, pp. 261-271, figs. 210-224). Successively, during the summers of 1967 and 1968, the Asklopis area was again explored by R. Hope Simpson and J.F. Lazenby, in the context of their extensive surveys in the Dodecanese (Hope Simpson & Lazenby, 1970, pp. 55-66, figs. 5-7, pls. 19-20). Most recently, between 2018 and 2023, the Asklopis region was again investigated by the Επιφανειακή Έρευνα στο νησί της Κω-Kos Archaeological

Survey Project (KASP), a research endeavor conducted by M. Michailidou and T. Marketou in collaboration with S. Vitale and C. McNamee (McNamee et al., 2021; Vitale et al., 2021).

Morricone's excavations brought to light four EBA 2 graves, including three pithos burials and one stone-lined pit, as well as a limited amount of unstratified materials from a trial trench dug in the vicinity of the tombs (Morricone, 1975, pp. 261-271; Vitale, 2013). Inhumation was the only identified mortuary treatment for all burials (Vitale, 2013, p. 52, tab. 1; Vitale et al., 2017, p. 247, tab. VIII). Hope Simpson and Lazenby's work resulted in the collection of a small assemblage of surface finds scattered on top and around the Asklopis Hill. The materials from Morricone's trial trench and Hope Simpson and Lazenby's survey have a wide chronological range, spanning from the FN 1 to the Roman period (Vitale & Morrison, 2018; Vitale, 2024).

Hope Simpson and Lazenby were the first to suggest the existence of a prehistoric settlement on the east slopes of the Asklopis ridge, which they identified as «an obvious prehistoric acropolis» (Hope Simpson & Lazenby, 1970, p. 57; see also Marketou, 2004, pp. 23-25; Marketou, 2010, p. 762). As implied by SELAP's study of the finds from both Hope Simpson and Lazenby's survey and Morricone's trial trench, some form of settlement must have existed in this area in the phases between the FN 1 and the EBA 2, during which the Asklopis was likely a hamlet made of a few family units (Vitale & Morrison, 2018, pp. 57-61). The EBA 2 burial cluster must have represented the cemetery area of the small community living at the site at some point during the 3rd millennium B.C.E. An important rural village also existed at the Asklopis in the LBA and the EIA (Vitale, 2024). These conclusions were all recently confirmed by the first published results of KASP (McNamee et al., 2021; Vitale et al., 2021).

1.2 The “Serraglio”: EBA 3 to LPG

Archaeological fieldwork at the prehistoric site of the “Serraglio” (figs. 1, 3-5) was originally carried out by L. Morricone from 1935 to 1946 (Morricone, 1975; Morricone, 1982) and later by the Greek Archaeological Service, especially T. Marketou, in the late 1970's and the 1980's (Marketou, 1990a; Marketou, 1990b; Marketou, 2010). Despite having investigated also the so-called Pizzoli, Fadil, and Halvaghia sectors (Morricone, 1975, p. 145), Morricone's excavations were mainly concentrated in Zones I and II of the “Serraglio” (fig. 3). Marketou completed numerous rescue excavations in the broader “Serraglio” area that were, however, more limited in size compared to Morricone's (Marketou, 2010, with previous bibliography).

Above the EBA 3 Early to LBA settlement brought to light by Morricone's and Marketou's excavations, a large Middle Protogeometric (MPG) to Late Geometric cemetery was unearthed by Morricone (Morricone, 1982), with the most significant concentration of burials located in Zones I-II of the “Serraglio” (fig. 3). The deceased mostly consisted of children, but a few adults were also recovered. The tombs included only single burials in cists, pits, or pithoi and inhumation was the standard body treatment (Morricone, 1982; Vitale 2023b, p. 62).

Although an occupational gap was proposed between the latest LBA structures at the settlement of the “Serraglio” and the construction, in the same area, of the first



fig. 3. The LBA settlement of the “Serraglio”. a: Map showing Morricone’s main excavation sectors outlined in grey. b: Map showing the EIA tombs and the LBA vessels found *in situ* within the buildings of Sub-Phases III:2, 3, and 4. The locations of the EIA tombs are indicated by the occurrence of cardinal numbers (a: after Morricone, 1975, p. 152, fig. 7; b: after Morricone, 1975, p. 159, fig. 21, adapted by C. McNamee & S. Vitale).

MPG tombs, SELAP’s recent study of the stratigraphy and the finds has demonstrated the existence of an interrupted LBA-EIA sequence at the site (Vitale et al., 2017, pp. 231-233, fig. 4; Vitale, 2023b, both with previous bibliography). This conclusion agrees with Morricone’s preliminary assessment of the data (Morricone, 1982, pp. 46-50; Vitale, 2023b). According to SELAP’s results, Zones I and II of the “Serraglio”, which were the center of the LBA urban space, gradually turned into the settlement’s outskirts and, eventually, became the ideal location for the EIA cemetery in the MPG phase (Vitale, 2023b, p. 74).

1.3 Eleona and Langada: LBA II to LH IIIC Middle/Late

Eleona and Langada were the main cemeteries used by the LBA community living at the “Serraglio”. Morricone excavated these necropoleis in their entirety in two main campaigns during the autumn of 1935 and the autumn of 1940 to the winter of 1941 respectively (figs. 1, 6-8). The results of these investigations were published some 25 years afterwards (Morricone, 1967). Because of the lack of excavation diaries for Tombs 1-20 from Eleona (Morricone, 1967, p. 9, with note 1), few details are known about the exact location, stratigraphy, and architectural features of the graves from this

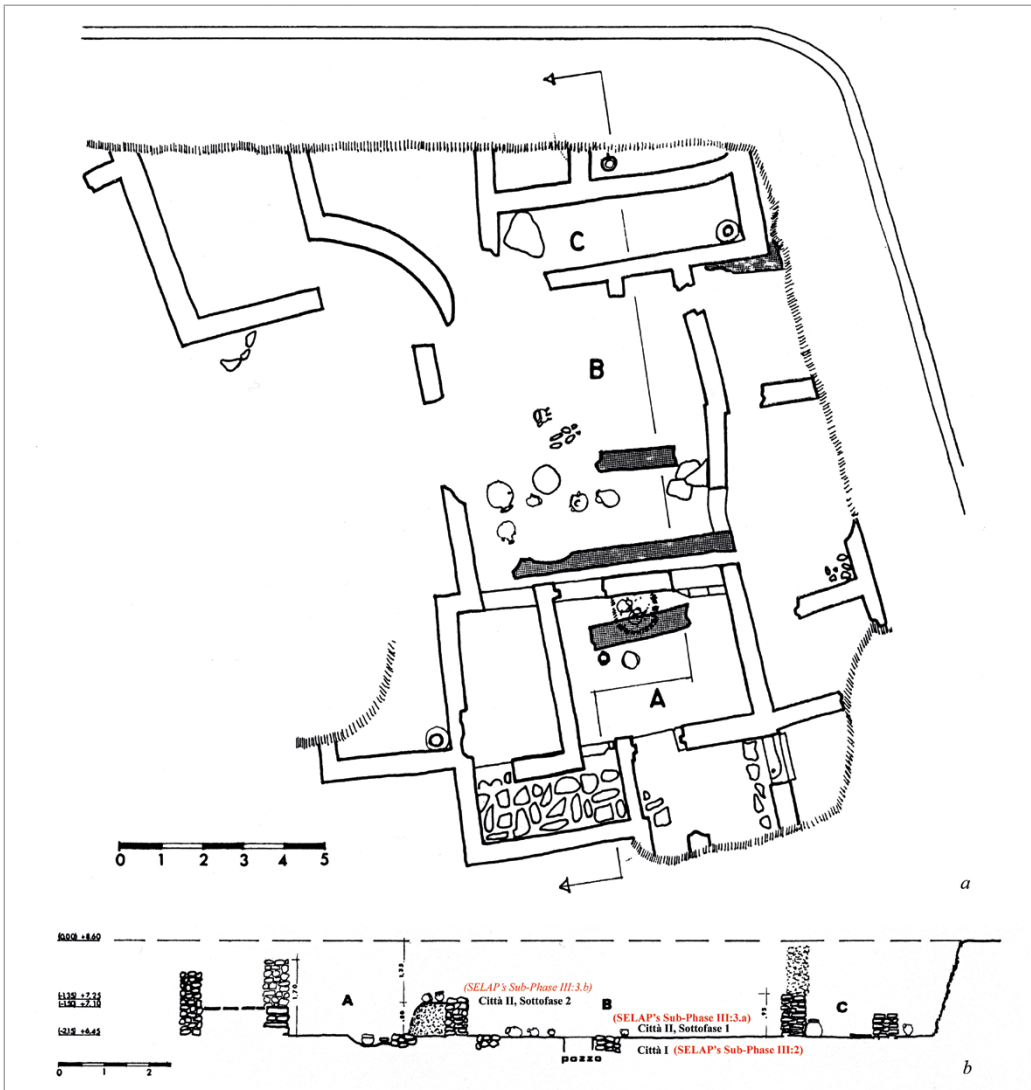


fig. 4. The LBA settlement of the “Serraglio”. a: Structural remains from Sub-Phases III:2 (grey) and III:3.a-b (white) from Morricone’s 1941 excavations in Zone II of the “Serraglio”; b: Reconstructed section of the same structural remains (after Morricone, 1975, p. 210, figs. 121-122, adapted by S. Vitale).

cemetery (Vitale, 2023a). More precise information is available for Langada, where the resolution of the data, although not comparable with modern standards, permits a fuller spatial and contextual analysis (Morricone, 1967, pp. 13-17, 22-25, figs. 1-3; McNamee & Vitale, 2020).

Morricone described the modern terrain at Eleona and Langada as a gentle hill sloping towards the north and west, with a small ephemeral drainage separating the two cemeteries, Langada being located on the east side and Eleona on the west (Morricone, 1967, p. 7). While not providing the exact locations of the Eleona tombs,

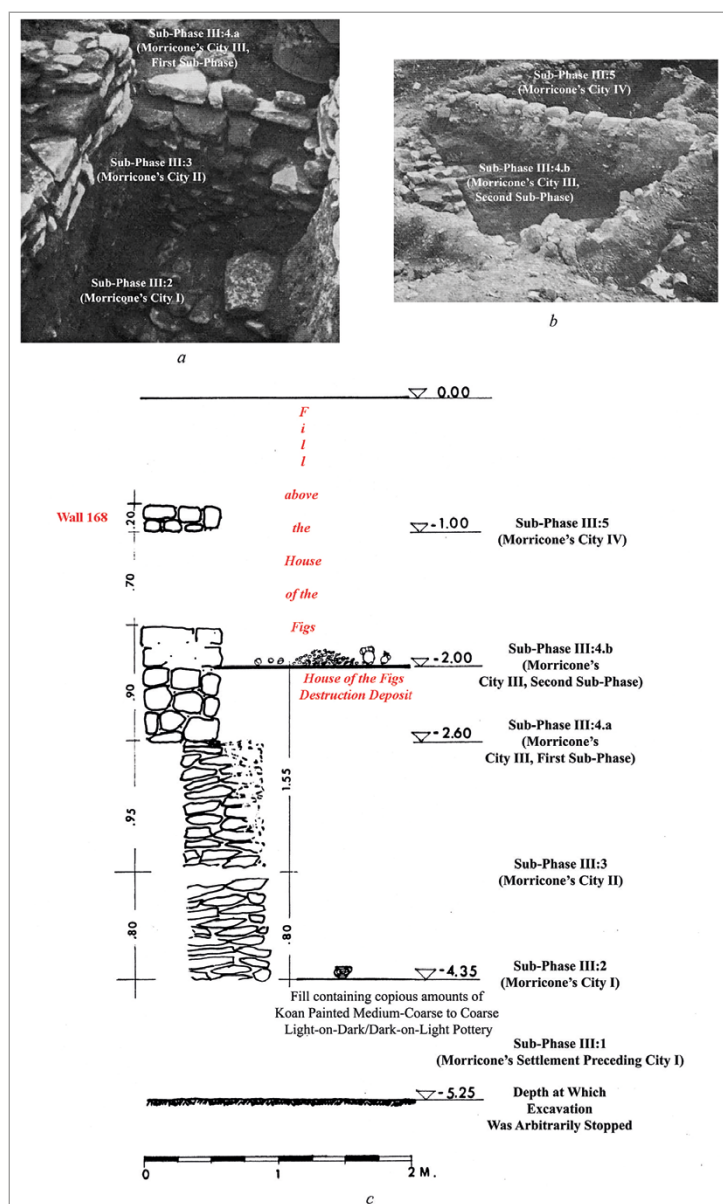


fig. 5. The "Serraglio", Zone II, NW corner. a-b: View of the walls of Sub-Phases III:2-5; c: Reconstructed stratigraphic section (a-b: after Morricone, 1975, pp. 227, 231, figs. 154, 159, adapted by S. Vitale; c: after Morricone, 1975, p. 230, fig. 158, adapted by S. Vitale).

Morricone reports that they were all built in a single row on the slopes of a low hill facing north (Morricone, 1967, pp. 7-9). The Langada tombs were set on the slopes of a hill facing west and, with a few exceptions, their exact position is known (Morricone, 1967, pp. 13-17).

Because of the gentle modern topography, the cemeteries of Eleona and Langada were initially interpreted as pit graves by Morricone's assistant G. Lazzara (see Laurenzi, 1936, p. 141). However, Morricone later envisioned a significantly altered LBA landscape with a wide, but deeply incised south-west to north-east drainage creating the hills into which the tombs were built (Morricone, 1967, pp. 13-17). In his

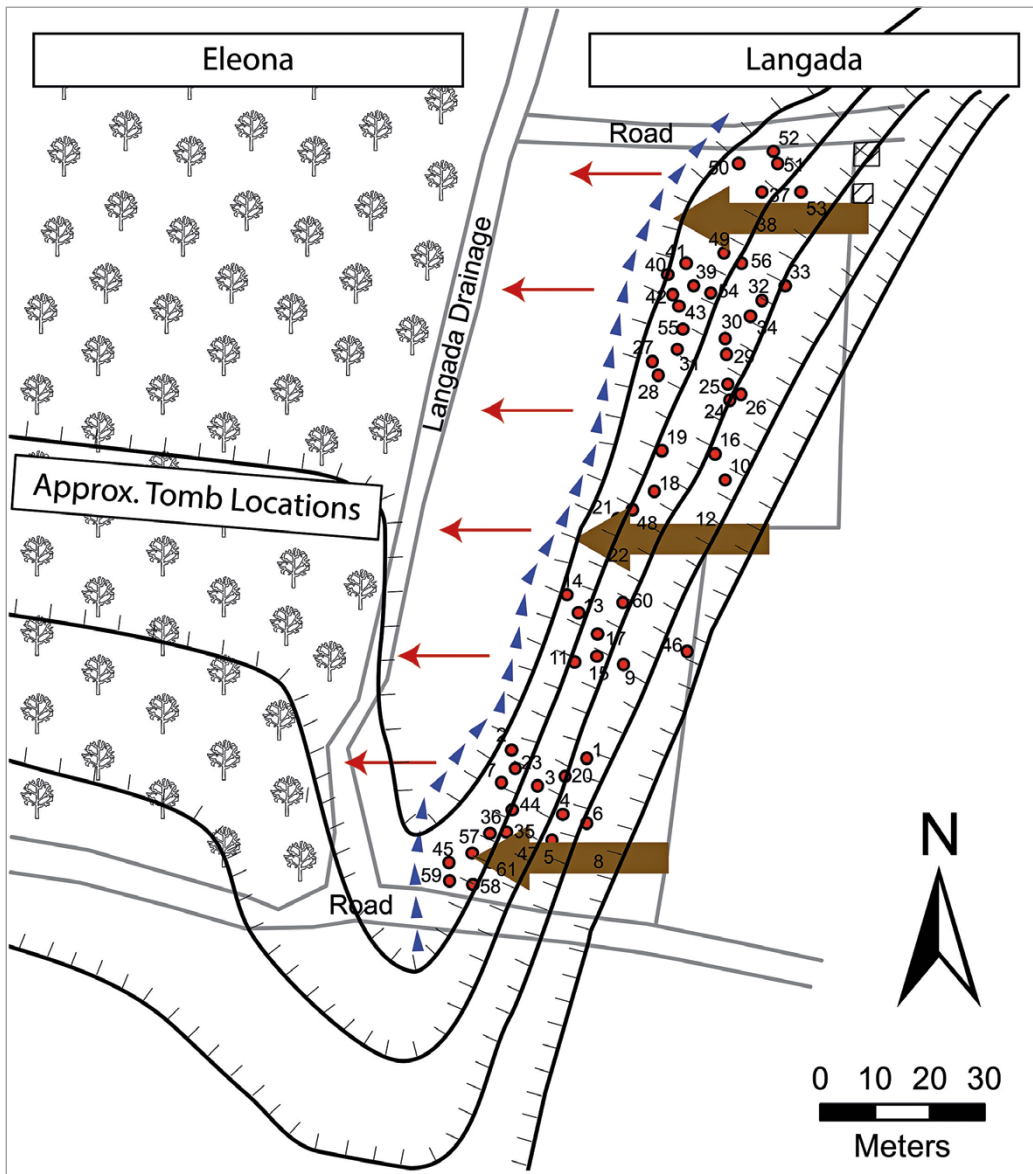


fig. 6. Map showing Morricone's reconstructed burial landscape at Langada, with SELAP's revisions and interpolations for both Eleona and Langada (C. McNamee & S. Vitale, after Morricone, 1967, pp. 9-10, figs. 2-3).

reconstruction (**fig. 6**), the migration of the drainage and the deposition of sediments eroded from the Langada Hill gradually leveled out the topography at the site, with all the burials being eventually identified as chamber tombs (Morricone, 1967, 13-17; see also McNamee & Vitale, 2020, pp. 216-218; Vitale, 2023a, pp. 9-12).

SELAP's recent modeling of the Eleona and Langada burial landscapes (**fig. 7**) has to a large extent confirmed Morricone's original reconstruction (McNamee & Vitale,

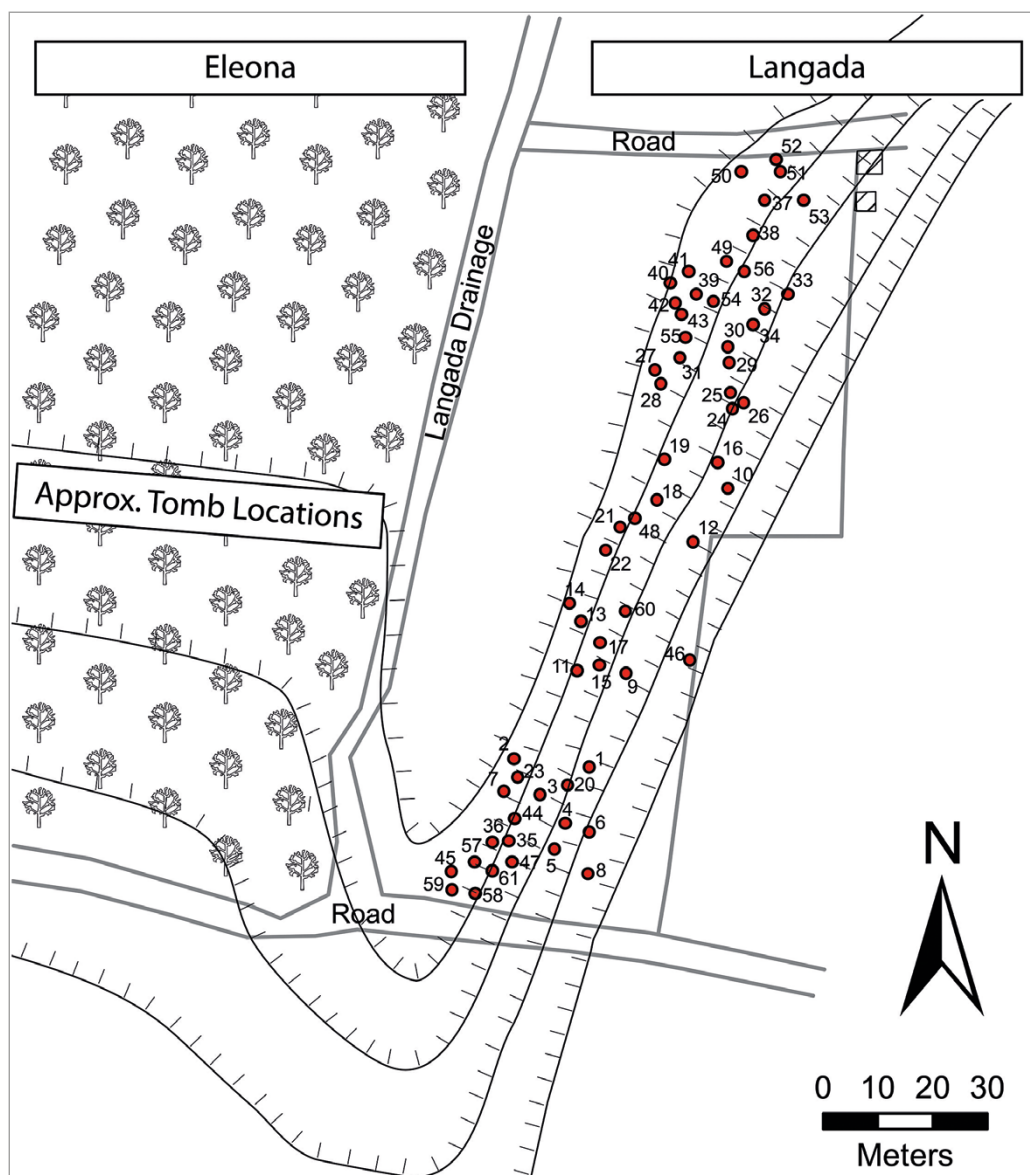


fig. 7. Map showing SELAP's reconstructed burial landscape at Eleona and Langada (C. McNamee & S. Vitale, after Morricone, 1967, pp. 9-10, figs. 2-3).

2020; Vitale, 2023a, pp. 14-20). The re-study of tomb categorization, however, has significantly modified Morricone's conclusions. Based on a thorough contextual analysis of the tombs' shapes, architectural features, mortuary remains, and associated finds, SELAP's demonstrated that only 44 graves at Langada were in fact chamber tombs (DR, File 1_a_tab. 1). The remaining 17 graves from this cemetery were identified as possible simple pits (Vitale et al., 2017, pp. 243-247, tabs. IX-XI; McNamee & Vitale, 2020, p. 222, tabs. 11:3-11:4; Vitale, 2023a, pp. 20-21, tab. 6). At Eleona, at least 14

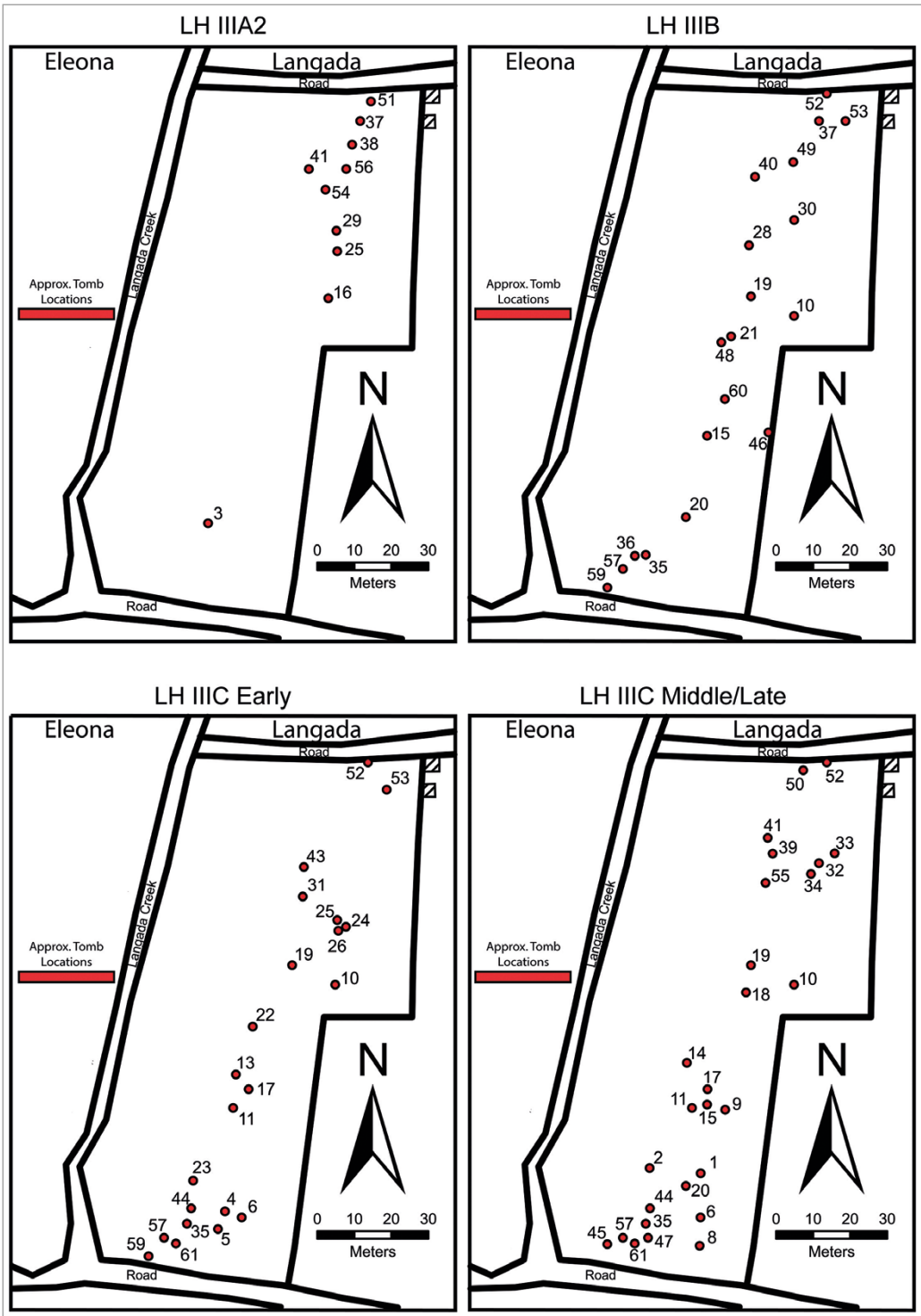


fig. 8. Spatial distribution of the tombs used at Langada during LH IIIA2, LH IIIB, LH IIIC Early, and LH IIIC Middle/Late (C. McNamee & S. Vitale).

tombs can be classified as chamber tombs, because of the presence of multiple interments and, in one case, based on the remains of the original blocking wall (DR, File 1_a_tab. 2). It is possible that the other eight graves from this cemetery were pits, but this conclusion must be considered hypothetical, because of the limited information available for Eleona's Tombs 1-20.

Regardless of the tomb type, inhumation was the standard body treatment also at Eleona and Langada (Vitale et al., 2017, pp. 249-254). A few cases of cremation, dated between LH IIIA2 or LH IIIB and LH IIIC Middle/Late, did nevertheless occur at both cemeteries (Vitale et al., 2017, pp. 250-254, tab. XIV).

2. Dataset and Methodology

SELAP's uses a holistic approach to the study of relative chronologies and occupational sequences (fig. 9). The project's methodology places at the very center of the epistemological process the concept of archaeological context, seen within its broader urban or funerary landscapes. Understanding formation processes is also of key importance, because they have significant implications for the chronological definition of archaeological deposits. The implementation of standardized terminologies and definitions is another decisive feature of SELAP's methodology. Rigorous nomenclatures, adequately reflecting and at the same time informing the project's research questions, are key to data storage strategies and the performances of effective chronological queries.

2.1 Data Challenges

As seen in Section 1, while incorporating information from more recent archaeological research, SELAP's analysis of the sites of the Asklepis, the "Serraglio", Eleona, and Langada is primarily based on L. Morricone's excavations (Morricone, 1967; Morricone, 1975; Morricone, 1982) and Hope Simpson and Lazenby's survey (Hope Simpson & Lazenby, 1970). Being affected by the typical limitations of legacy data, this large body of materials requires extreme analytical and interpretative caution.

Despite Morricone's attention to stratigraphy, the quality of the information from his excavations is uneven, especially if compared to modern standards. For example, the materials recovered by Morricone exhibit important biases due to the discard strategies typical of the 1930's and 1940's. Most unpainted and medium-coarse to coarse pottery sherds were not kept, especially if not immediately associable with Minoan, Mycenaean, and Greek EIA shapes. In the late 1960's, Hope Simpson and Lazenby operated in similar ways, picking up mostly painted fragments or fine unpainted feature sherds.

Another problem affecting the resolution of Morricone's excavations data is the partial destruction of the original field notebooks, which occurred during the dramatic events of World War II (Morricone, 1967, p. 9 with note 1; Morricone, 1975, pp. 147-149). Lost information includes most of the diaries from the excavations at the "Serraglio", those from Eleona's Tombs 1-20 (see above, Section 1), as well as detailed drawings of plans, archaeological sections, and architectural features (Morricone, 1967, pp. 9, 76, 80, 82; Morricone, 1975, pp. 147-149, 388).

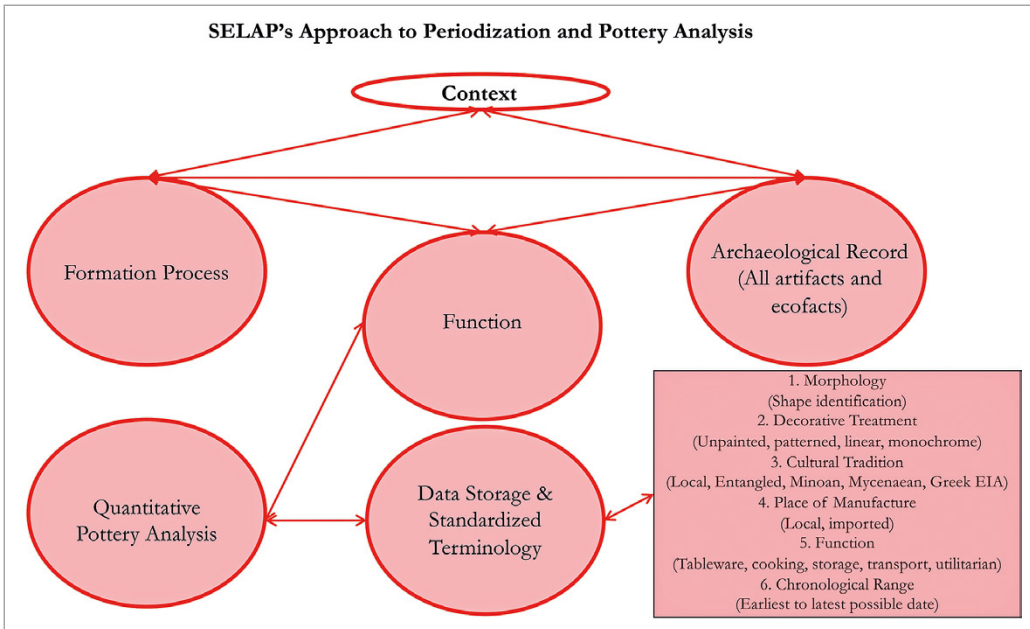


fig. 9. Diagram showing SELAP's contextual approach to periodization and pottery analysis (S. Vitale).

2.2 Context

Context was recently described as «the critical study of artifacts and ecofacts, matrices, features, and their unique spatial and temporal associations» (Haggis & Antonaccio, 2015, p. 2). This definition is of chief importance, because it emphasizes the significant role of formation processes in shaping the archaeological record. The latter is «a fluid, dynamic, and open-ended construct born of archaeological practice, formed initially by excavators, but also from an on-going dialectic between investigators, sites, assemblages, objects, and a myriad of analytical and theoretical framework» (Haggis & Antonaccio, 2015, p. 9). This definition of what the term archaeological record means is particularly relevant for a project like SELAP, the main focus of which is represented by legacy data that were produced in a completely different methodological, theoretical, and heuristic setting.

2.3 Formation Processes

In terms of formation processes, within the wide range of Morricone's excavations, the most significant distinction concerns primary (or closed) vs. secondary (or mixed) contexts (Vitale et. al., 2022b, pp. 123-124, with previous bibliography). The former typically consist of four types (Vitale, 2012, 1235, with previous bibliography): (a) Floor deposits; (b) Underfloor terracing fills stratified in-between a sequence of floor deposits; (c) Single burials in chamber tombs or pit graves (Morricone, 1967, p. 26); and (d) Individual interments (and their associated objects) that do not appear to have been disturbed after their original placement in pitthoi, chamber tombs, or pits (Morricone, 1967, pp. 27-28).

Finds from a miscellaneous array of secondary contexts, typically mixed fills, mixed underfloor fills, or unstratified materials of known and unknown provenance, are also cautiously considered as an additional, although problematic, analytical resource. In fact, even these contexts sometimes include items that, because of their place of manufacture, their morphology, and/or their decorative treatment, can provide basic evidence for time periods or cultural contacts that are otherwise scanty or completely missing.

Within secondary contexts, a special group is represented by the pithos burials, chamber tombs, and pit graves, which included what A. Furumark called “homogeneous find groups” (Furumark, 1941b, pp. 32-33; Vitale, 2012, 1235, with previous bibliography). These groups consist of assemblages, which may be stylistically assigned to a single broad chronological phase, e.g. EBA 2, LBA II, LBA IIIA1, LH IIIA2, LH IIIB, LH IIIC Early, and LH IIIC Middle/Late, although their original context was disturbed.

2.4 Periodization

SELAP’s approach to periodization is strictly dependent on the project’s definition of archaeological contexts and formation processes. The establishment and the study of occupational phases and chronological horizons is based on the combined observation of two interrelated factors: (Vitale et. al., 2022b, pp. 123-124, with previous bibliography): (a) The stratigraphic and functional characteristics of contexts; and (b) The quantitative distribution of diagnostic features and their variations through space and time. Through this methodology, all the chronological components of a given deposit are integrated within a wider understanding of context and its functional meanings.

As is typical in Aegean prehistory and protohistory, the main analytical tool used to build SELAP’s periodization is pottery seriation. As far as ceramic sequences are concerned, SELAP’s methodology uses a combination of traditional systems based upon the appearance/disappearance of diagnostic features and the quantitative approach developed by K. Kilian, G. Schönfeld, and C. Podzuweit during the 1970’s and 1980’s excavations at Tiryns (Kilian, 1988, p. 118; Schönfeld, 1988; Podzuweit, 2007; Vitale, 2012, p. 1235; Vitale et al., 2022b, 123-126). According to this methodology, pottery styles go through three successive stages, which can be visualized as a bell curve showing their manufacturing and consumption trajectories. These stages encompass: (a) An initial phase, where innovative elements begin to be manufactured on a small scale; (b) A floruit, which represents the peak of production, and (c) A fading stage, when a style slowly disappears. As a result, the periods of manufacture and consumption of different styles may overlap, and closed deposits may contain features of different styles. In this case, primary deposits are dated based on the ceramic types that constitute the majority of the sample. The presence of single or isolated features associated with the innovative and/or fading stages of a given style must not be considered decisive for dating purposes.

2.5 Storage Data Strategies

SELAP’s database reflects in a summarized fashion the project’s methodology and is built as a handy tool to enable a wide array of queries that concern the project’s main research questions. To do so, Filemaker layouts have been implemented to record relevant information on contexts, ceramics, and a diverse array of other finds (Folder

1, File 1_b), with individual fields within each layout designed to address the project's primary research questions (Vitale et al., 2023, pp. 17-19; Nani et al., forthcoming).

Dropdown values exist for most fields to maintain recording consistency, facilitate queries, and standardize the analysis and the study of the dataset. The layouts are linked to high resolution context and artifact illustrations (including photographs, pencil drawings, and inkings), and are relational, thus enabling, when needed, the automatized population of interconnected fields, as well as the easy and fast performance of complex queries (Folder 1, File 1_b).

3. Occupational and Stratigraphic Sequences

This section presents the occupational and stratigraphic sequences identified through SELAP's research in the northeast Koan region. As in Section 1, the data are presented in chronological order, based on the foundation date of each site.

3.1 The Asklopis: FN 1 to LPG (with possible gaps)

SELAP's work has demonstrated the existence of a long occupational sequence at the Asklopis and its surrounding area (DR, File 1_a_tabs. 3-4). Three main horizons with human occupation have been recognized for the periods under study. Phase I includes the time span between the FN 1 and the EBA 2. Phase II can be broken down into three Sub-Phases, indicated as II:1-3. Sub-Phase II:1 dates between LBA IA Early and LBA IA Mature. Sub-Phase II:2 includes LH IIIA2 and LH IIIB, while Sub-Phase II:3 corresponds to LH IIIC Middle to LH IIIC Late. Finally, Phase III includes the LPG period. Cultural material gaps do exist between the abovementioned phases. Missing horizons include the following temporal ranges: EBA 3-MBA, LBA II-LBA IIIA1, LH IIIC Early, Early Protogeometric (EPG), and MPG.

The occurrence of a hiatus between the EBA 3 and the MBA periods is possible at the Asklopis, based on broader site distribution patterns on northeast Kos during these phases (Vitale et al., 2017, pp. 238-241; Vitale et al., 2021, p. 116). The absence of materials dating to LBA II-LBA IIIA1, LH IIIC Early, EPG, and MPG, on the other hand, should not be considered as definitive proof for occupational gaps in these periods, but rather as the outcome of the limited number of the materials recovered at the Asklopis and the dearth of a significant amount of contextual data (Vitale et al., 2017, pp. 238-241, 243-247, 278-279; Vitale et al., 2022a, pp. 156-157, 161-162; McNamee & Vitale, 2020, pp. 240-244; Vitale, 2021, pp. 529-545, 553-555; Vitale, 2024).

3.2 The "Serraglio": EBA 3 to LPG

During prehistory and protohistory, the "Serraglio" was continuously occupied from the EBA 3 up until the end of the LPG period. For the LBA, while Morricone had identified four macrophases defined as "Cities" I-V, collaborative research between SELAP and Marketou has recognized the existence of five Sub-Phases, categorized as III:1 to III:5, with further bipartite sub-divisions for III:1, III:3, and III:4 (DR, File 1_a_tab. 5). In this more recent framework, Phases I and II correspond to the EBA 3

and MBA periods respectively, with Phase I being further sub-divided into Sub-Phase I:1 (EBA 3 Early) and Sub-Phase I:2. (EBA 3 Late).

Finally, based on SELAP's recent results (DR, File 1_a_tab. 5), the Protogeometric (PG) period at the "Serraglio" is broken down into two sub-phases. The earlier one, Sub-Phase IV:1, dates to EPG-MPG and corresponds to the time span when the size of the settlement had likely shrunk and Zones I-II had become the outskirts of the urban space (Vitale, 2023b, p. 74). Sub-Phase IV:2 dates to MPG-LPG and corresponds to the initial phases of the EIA cemetery. Specifically, Sub-Phase IV:2 includes 4 MPG, 1 MPG-LPG, and 16 LPG graves (Morricone, 1982, pp. 13-50; for a few additional PG tombs, which were recently discovered by the Ephorate of Antiquities of Dodecanese, see Lemos, 2002, pp. 17, 22-23, 180-182; Palmieri, 2015, p. 135, both with previous bibliography).

3.3 Eleona and Langada: LBA II to LH IIIC Middle/Late

Overall, three main phases of use can be recognized at Eleona and Langada (DR, File 1_a_tabs. 6-8). The earlier one is only found at Eleona (Morricone, 1967; Vitale et al., 2017, 233-234, tabs. IV-VII). It corresponds to Phase III:3.a-b at the "Serraglio" (LBA II-LBA IIIA1) and equates to the late Prepalatial period of Mycenaean civilization on the Greek mainland. The second phase of use is common to both Eleona and Langada, with the latter now representing by far the largest cemetery used by the community of the nearby settlement of the "Serraglio". This second stage corresponds to Phase III:4.a-b at the "Serraglio" (LH IIIA2-LH IIIB) and equates to the Palatial period of Mycenaean civilization on the Greek mainland. The third and final temporal range of use of Eleona and Langada corresponds to Phase III:5 at the "Serraglio" (LH IIIC Early-LH IIIC Middle/Late) and equates to the Postpalatial period of Mycenaean civilization. Langada remains the largest of the two cemeteries used by the "Serraglio" inhabitants also during this final time span.

The only burial, which may postdate the end of the LBA, is a pithos single interment of a child set into the original dromos of Chamber Tomb 58 at Langada. This type of mortuary behavior is similar to that characteristic of infant burials at the EIA cemetery of the "Serraglio". Unfortunately, only a bronze awl and a bronze scalpel were found within the burial pithos from the dromos of Chamber Tomb 58, preventing any precise dating of this context.

4. Contexts

This part of the paper discusses the contexts used by SELAP to identify and date the occupational and stratigraphic sequences presented in Section 3. For each of the main four sites considered by the project, an overview of the evidence is provided, according to the formation processes recognized (see above, Sub-Section 2.3). Additional information is included in the associated DR section (Folders 2-4), with tabular charts summarizing the main features of each context, its stratigraphic position, and its chronological placement.

4.1 The Asklopis: FN 1 to LPG (with possible gaps)

4.1.1 Primary Contexts

According to Morricone, at least one of the deceased individuals from Tomb 1 at the cemetery of the Asklopis was recovered in a primary position (Vitale, 2013, p. 52). This conclusion cannot be verified based on the currently available sample of osteological remains.

4.1.2 Secondary Contexts

All the materials from Tombs 1, 2, 3, and 4 at the Asklopis represent stylistically homogeneous find groups (DR, Files 2_a-c). Based on these items, the entire cemetery can be assigned to the end of Phase I at this site, dating to the local EBA 2 period (DR, File 1_a_tabs. 3-4). Unstratified materials from Morricone's trial trench and Hope Simpson and Lazenby's survey (DR, Files 2_d-e) have little contextual meaning, but they are useful to reconstruct the main chronological trends in human activities at the Asklopis, especially when seen in the wider picture of settlement patterns in the northeast Koan region, as known through SELAP's and KASP's recent research (Vitale, 2012; Vitale et al., 2017; McNamee et al., 2021; Vitale et al., 2021; Vitale, 2024). As stated in Sub-Section 3.1, these materials can be assigned to the Asklopis Phase I (FN 1-EBA 2), Phase II:1-3 (a large portion of the LBA), and Phase III (LPG).

The complete list of identified secondary contexts from the Asklopis is provided within Folder 2 of the DR section (File 2_a), including summarized tabular catalogues of the relevant finds (Files 2_b-e).

4.2 The “Serraglio”: EBA 3 to LPG

4.2.1 Primary Contexts

No primary contexts were uncovered by Morricone from Phases I (EBA 3 Early to EBA 3 Late) and II (MBA) at the “Serraglio”. The only available information for this time periods comes from the excavations conducted by Marketou (Marketou, 1990a; Marketou, 1990b; Marketou, 2010). Morricone, on the other hand, brought to light several floor deposits dating to Phase III (LBA). These assemblages (DR, File 1_a_tab. 5), attributable between Sub-Phase III:1.a (LBA IA Early) and the end of Sub-Phase III:5 (LH IIIC Middle/Late), represent a precious dataset to understand the relative chronology of the building phases at the site (DR, Files 3_a-c).

In addition to floor levels, the most informative underfloor terracing deposit recovered by Morricone at the “Serraglio” is the fill stratified underneath the so-called House of the Figs (DR, Files 3_h-i). Despite being partially disturbed, this context provides valuable data on Sub-Phase III:4.a (DR, File 1_a_tab. 5; LH IIIA2 to LH IIIB1). Several other underfloor fills stratified below horizons assignable to Sub-Phase III:2 (LBA IB) are discussed by Morricone in the original publication of his excavations at the “Serraglio”. Dating to Sub-Phase III:1.a-b (LBA IA Early to Mature), these deposits were characterized by large numbers of locally produced Minoan Unpainted Fine (MiUF) conical cups and Koan Painted Medium-Coarse to Coarse, Light-on-Dark/Dark-on-Light (LoD/DoL) fragments (for Koan pottery classes, see

below, Sub-Section 5.2). Unfortunately, among the materials currently kept in the storerooms of the Ephorate of Antiquities of Dodecanese on Kos, there is not a single box that can be conclusively matched with these underfloor terracing fills (see Vitale, 2018, 53-59).

The complete list of identified primary contexts from the “Serraglio” is provided within Folder 3 of the DR section (File 3_a), including a summarized tabular catalogue of the relevant finds (Files 3_b-c, h-i).

4.2.2 Secondary Deposits

Within secondary contexts from the “Serraglio”, a special mention is needed for the Fill above the House of the Figs (fig. 5; DR, Files 3_a, f-g). This deposit was excavated in a hasty fashion in 1946, in the last days of Morricone’s investigations on Kos (Morricone, 1975, pp. 227-232, figs. 154-160). Due to time constraints, the finds from underneath and above the structures of Sub-Phase III:5 were partially mixed, as demonstrated by a LH IIIC Middle to Late stirrup jar of Furumark’s Shape 175/176 with joins from above and underneath Walls 168 and 169, both of which date to Sub-Phase III:5 (fig. 5c; Vitale, 2023b, p. 63, fig. 3). Nevertheless, the Fill above the House of the Figs is particularly important for at least two reasons. First, no stratigraphic hiatus in ancient human activities in this part of the “Serraglio” was recognized by Morricone (Morricone, 1975, pp. 227-232, figs. 154-160). Second, the fragments from this deposit show the occurrence of all chronological phases between LH IIIB2 Late to LH IIIC Early and the LPG period (Vitale, 2023b, pp. 63-66, figs. 4-5). Combined, these data demonstrate that occupation continued uninterrupted at the “Serraglio” during the LBA to EIA transition (DR, File 1_a_tab. 5), bringing to a close long-lasting debates associated with major historical questions, such as the so-called first wave of Greek colonization in the 10th century B.C.E. (Vitale, 2023b, p. 75). Moreover, the information from the Fill above the House of the Figs also proves that LH IIIC Late and EPG vessels did exist at the “Serraglio”, although the latter occurred only on a small scale (see Vitale, 2023b, 72-75).

Finally, a limited but occasionally important contribution to our knowledge of the chronological sequence of the “Serraglio” is provided by a small number of stray finds from unknown contexts (DR, Files 3_d-e). The most relevant cases concern the MBA, the MBA to LBA transition, and the LBA to EIA transition. First, a stray Middle Minoan (MM) IIA to MM IIB LoD polychrome cup recently published by SELAP represents the earliest known Cretan import from the “Serraglio” (Vitale & Querci, 2024, p. 436, fig. 2: a). This single stray find does not come from Morricone’s excavations but was identified by SELAP within the materials stored in the collection of the British School at Athens. This vessel demonstrates that the first contacts between Crete and Kos began in the Minoan Protopalatial phase, i.e. approximately as early as at other important centers in the Southeast Aegean-Southwest Coastal Anatolian Region (SASCAR), such as Miletus and Ialysos on Rhodes. Second, a few stray MiUF handleless cups with a shallow profile from Morricone’s excavations indicate that the earliest manufacture of Cretan type vessels on Kos dates to a phase contemporary with MM IIIA (Morricone, 1975, p. 282, nos., 1244, 1361, fig. 244), i.e. around the MBA to LBA transition in the island’s local sequence (DR, File 1_a_tab. 5; Files

3_d-e). Third, together with the materials from the Fill above the House of the Figs, some stray pottery fragments from Morricone's excavations that can be typologically assigned to the LH IIIC Late, EPG, MPG, and LPG phases confirm that all these ceramic styles did exist on Kos and that no occupational break took place during the LBA to EIA transition or later before the establishment of the EIA cemetery of the "Serraglio" (Vitale, 2023b, pp. 73-75). The presence of stray EPG to LPG pottery imports from central Greece, the Argolid, and Attica (Vitale, 2023b, pp. 67-68, 70) demonstrates that cultural relationships between Kos and the Greek mainland existed throughout the 10th century B.C.E.

The complete list of identified secondary contexts from the "Serraglio" is provided within Folder 3 of the DR section (File 3_a), including a summarized tabular catalogue of some of the relevant finds (Files 3_d-g). Secondary contexts from other smaller sites explored by Morricone or Hope Simpson and Lazenby are also listed in Folder 3 (File 3_a, d-e).

4.3 Eleona and Langada: LBA II to LH IIIC Middle/Late

4.3.1 Primary Contexts

The contextual study of the vases from Langada established the existence of 20 closed groups (DR, Files 4_a-e). Among these assemblages (DR, File 1_a_tabs. 6-8), 12 are single interments from three chamber tombs (Langada's nos. 7, 21, 38), eight pit graves (Langada's nos. 1, 18, 23, 24, 36, 42, 43, 46), and one pithos burial (from the dromos of Langada's Chamber Tomb 58). The remaining eight closed groups (DR, Files 4_a-e) represent undisturbed assemblages assignable to specific interments, all from two multiphase chamber tombs (Langada's no. 25, Groups 1-5; and Langada's no. 57, Groups 2-4). These contexts cover the entire time span between LH IIIA2 and LH IIIC Middle/Late, corresponding to Sub-Phases III:4.a-b and III:5 at the "Serraglio".

The complete list of identified primary contexts from Eleona and Langada is provided within Folder 4 of the DR section (File 4_a), including summarized tabular catalogues of the relevant finds (Files 4_b-e).

4.3.2 Secondary Contexts

A total of 38 stylistically homogeneous groups were identified at Eleona and Langada (DR, File 1_a_tabs. 6-8; DR, Files 4_a-e). Eight were recognized in Eleona's Tombs no. 1, 3, 5, 14, 17, 19, 22, 23, which might have been pit graves. The remaining 30 stylistically homogeneous groups from Langada come from a variety of contexts, including 21 chamber tombs (Langada's nos. 4, 5, 9, 13, 14, 28, 29, 30, 31, 34, 39, 40, 45, 48, 49, 50, 51, 54, 55, 56, 60) and nine pit graves (Langada's nos. 2, 3, 8, 16, 22, 26, 32, 33, 47).

Outside these assemblages, the materials from tombs with multiple phases of use at Eleona and Langada, as well as some stray finds from Langada were dated either stylistically or by association with other diagnostic specimens (DR, Files 4_f-m).

The finds from secondary contexts from Eleona and Langada cover the whole temporal range from LBA II to LH IIIC Middle/Late, corresponding to Sub-Phases III:3.a.b, III:4.a-b, and III:5 at the "Serraglio" (DR, File 1_a_tabs. 5-8).

The complete list of identified secondary contexts from Eleona and Langada is provided within Folder 4 of the DR section (File 4_a), including summarized tabular catalogues of the relevant finds (Files 4_b-m).

5. Finds

The FN 1 to LPG materials from the contexts presented in Sections 3-4 comprise a large and diverse assemblage (DR, Files 2_b-e; 3_b-i; 4_b-m). For SELAP's analysis, these items were broken down into two main categories: ceramics and non-ceramic objects. Ceramics objects include all types of Koan prehistoric and protohistoric pottery vessels. Non-ceramic objects consist of bronze vessels, bronze weapons and implements, stone tools, terracotta figurines, and weaving equipment, as well as precious and semi-precious adornments for the body and clothing. In addition to this array of man-manufactured items, SELAP's analysis also focused on the available sample of human osteological remains unearthed at the cemeteries of the Asklopis, Eleona, and Langada (Vitale, 2012; Vitale, 2013; Vitale et al., 2017).

In the following sub-sections, SELAP's approach to the analysis and the study of ceramic and non-ceramic finds is illustrated, with a major focus on pottery, which represents the most effective chronological type-fossil for the prehistoric and protohistoric Aegean.

5.1 Documentation and Catalogue Forms

All inventoried finds studied by SELAP are illustrated through drawings and high-resolution photographs and are documented and described through individual forms designed for this purpose. The reference systems used for the identification of ceramic objects are those provided by Furumark (Furumark, 1941a; Furumark, 1941b) and P.A. Mountjoy (Mountjoy, 1986; Mountjoy, 1999). The reference systems used for the identification of non-ceramic objects largely conform to those provided by the following scholars: N.K. Sandars and I. Kilian-Dirlmeier for bronze weapons (Sandars, 1963; Kilian-Dirlmeier, 1993); H.-G. Buchholz for arrowheads (Buchholz, 1962); N.G. Blackwell for bronze implements (Blackwell, 2011); E.B. French for terracotta figurines (French, 1971); and E.M. Konstantinidi for jewelry and other miscellaneous adornments (Konstantinidi, 2001).

For each inventoried ceramic entry, an analytical and a summarized tabular catalogue form exist. The former records the following features: (a) Dimensions; (b) Weights; (c) Shapes, decorations, and functions; (d) Chronological ranges; (e) Non-plastic inclusions (f) Maximum sizes of non-plastic inclusions; (g) Potting traditions, according to the Koan Ceramic Classification System (KCCS; see below, Sub-Section 5.2); (h) Macroscopic fabric groups (see below, Sub-Section 5.3); (i) Surface treatments; (j) Forming techniques; (k) Colors of surfaces, paints, and fractures, according to the Munsell Soil Color Charts; (l) Numbers and percentages of preserved parts; (m) Hardnesses, according to Moh's scale; and (n) Degrees of depositional and use wear. SELAP's summarized tabular catalogue form includes exclusively the

information mentioned at points a, b, c, d, f, g, h, and l (for most of which, see DR, Files 2_b-e; 3_b-i; 4_b-c, f-g, j-k). The summarized tubular catalogue is also filled out for non-inventoried pottery objects, in order to have a quantitative assessment of all the ceramics under SELAP's study. No drawings or photographs, however, exist for non-inventoried pottery objects.

As far as non-ceramic objects are concerned (DR, Files 2_b-c; 3_b-g; 4_d-e, h-i, l-m), the most significant information recorded through SELAP's catalogue form includes: (a) Dimensions; (b) Weights; (c) Shapes, decorations, and functions; (d) Chronological ranges; (e) Materials of manufacture; (f) Colors, according to the Munsell Soil Color Charts; (g) Numbers and percentages of preserved parts; and (h) Degrees of depositional and use wear. Among non-ceramic finds, because of their material of manufacture, the information recorded for terracotta figurines, loom-weights, and spindle whorls includes a mix of features common to both the ceramic and non-ceramic forms. All non-ceramic objects studied by SELAP' have an inventory number.

5.2 KCCS

Locally manufactured and imported vessels under SELAP's study are identified and described according to the KCCS, a comprehensive analytical tool organized according to four hierarchically applied criteria (DR, File 1_a_tabs. 9-11; see Vitale, 2017; Vitale, 2018, pp. 27-32; Vitale et al., 2017, pp. 255, tab. XV; Vitale & Morrison, 2017, p. 76, tab. 8:1; Vitale & Morrison, 2018, p. 41, tab. 2; Vitale, 2024, p. 31, tabs. 1-3). These criteria include: (a) Pottery tradition (Local vs. Entangled vs. Minoan vs. Mycenaean vs. Greek EIA); (b) Decorative treatment (Painted vs. Unpainted); (c) Color (Pale vs. Grey vs. Red vs. Dark vs. Black); and (d) Size of non-plastic inclusions ("Fine" vs. "Medium-Coarse" vs. "Coarse"). The term "fine" refers to fabrics with non-plastic inclusions no larger than 0.002 m. The term "medium-coarse" designates fabrics with the largest non-plastic inclusions ranging between 0.002 and 0.004 m. The term "coarse" indicates fabrics with non-plastic inclusions larger than 0.004 m (see Vitale, 2017, p. 153, with previous bibliography).

The benefits of the KCCS for the initial identification and classification of large pottery assemblages are simplicity, consistency, and flexibility. In addition, this system provides a ready and easy tool to assess and compare major cultural trends in deposits from different contexts and regions (for a similar approach, see Rutter, 1995, pp. 13-14, with previous bibliography). On Kos, for example, chronological shifts in the occurrence of vessels of Local, Entangled, Minoan, Mycenaean, and Greek EIA traditions reflect major cultural transitions that occurred on the island and the wider SASCAR between the MBA and the LPG phases.

5.3 Macroscopic Fabric Groups

While the KCCS is conceived for an initial and broad assessment of pottery assemblages, SELAP's macroscopic fabric analysis highlights more subtle differences that demonstrate material processing by ancient potters to create clay bodies. Macroscopic fabric analysis is thus an essential tool for a deeper comprehension of pottery

assemblages in preparation for petrography. Additionally, macroscopic fabric analysis is also extremely useful for exploring manufacturing technologies and their broader cultural meanings.

SELAP's macroscopic fabric groups are established based on paste characteristics, density and types of non-plastic and soft inclusions, hardness, and voids within the paste (DR, File 1_a_tabs. 12-13; Vitale & Morrison, 2017; Vitale & Morrison, 2018; Vitale et al., 2017). The density of non-plastic inclusions to the paste ranges from a "fine" to a "very coarse" clay body. The use of these terms for macroscopic fabric analysis does not correspond to the use of the terms "fine", "medium-coarse", and "coarse" in the context of the KCCS, as the latter only takes into account the maximum size of non-plastic inclusions, regardless of their frequency.

According to SELAP's analysis, the entire FN 1 to LPG Koan local assemblage corresponds to four main macroscopic fabric groups (DR, File 1_a_tab. 12; Vitale & Morrison, 2017; Vitale & Morrison, 2018; Vitale et al., 2017). Based on the density of non-plastic inclusions to paste, Group A includes fine and fine-medium fabrics, Group B includes medium fabrics, while Groups C and D include coarse to very coarse fabrics. All four groups have internal subdivisions based on the paste granularity of the dominant inclusions and the arrangement of non-plastic inclusions within the paste. In particular, Group A has eight sub-groups, Group B has 11 sub-groups, Group C has four sub-groups, and Group D has three sub-groups, thus making up a total of 26 sub-groups (DR, File 1_a_tab. 12).

6. Concluding Remarks

SELAP's results, entirely illustrated for the first time within this contribution, provide the most detailed set of chronological data ever produced on Kos and in the wider SASCAR during prehistoric and protohistoric times. In addition to the information gained on occupational sequences at the "Serraglio" and its surrounding areas, this article also shows that, when biases and limitations are critically addressed, legacy data still provide relevant insights for our current understanding of ancient human communities.

The proposed chronology, seen in the broader framework of its contextual data and associated finds, relies on SELAP's holistic approach to periodization, which is fully disclosed and critically reviewed in this article. The discussion of the project's core methodology and primary dataset reflects SELAP's deep conviction that sharing baseline information is not simply an effective publication strategy, but also a fundamental requirement of any proper scientific research carried out today.

An open approach to data sharing within an archaeological project and/or within the broader community of scholars is of crucial importance for the development of new methodological and theoretical questions. This contribution represents one of the first Aegean archaeology articles in which such a wide set of primary information is openly presented and discussed. It would certainly be good for the discipline if an increasingly large number of projects adopted in the near future the same approach as that undertaken here by SELAP.

Acknowledgments

SELAP's 2009 to 2024 seasons were made possible through generous grants and/or donations from: the Ministry of Education, Lifelong Learning and Religious Affairs of the Hellenic Republic; the Institute for Aegean Prehistory (INSTAP); the Shelby White Leon Levy Program for Archaeological Publications; the University of Calabria; the Mediterranean Archaeological Trust; the Rust Family Foundation; the University of Pisa, ProArcheo Call, 2024; the ArcheoClub d'Italia, sede di Pisa; and Miss Teresa Pirelli. SELAP is also very grateful to the former and present Directors of the Italian Archaeological School at Athens, Emanuele Greco and Emanuele Papi, for logistical and scientific support to the project. Last but not least, the author would like to warmly thank his friends and colleagues currently or formerly employed by the Ephorate of Antiquities of Dodecanese, especially M. Chalkiti, T. Marketou, M. Michailidou, F. Seroglou, and E. Skerlou.

The author is particularly grateful to C. McNamee, K. Dudlik, F. Nani, C. Allegro, and A. Maran for their collaboration in assembling the dataset presented in this article and for many critical discussions about its meaning. The author would also like to thank F. Bianchini, I. Camici, A. Filosi, A. Iacobelli, H. Indgjerd, L. Magno, J. Mokrišová, J.E. Morrison, D. Nenova, Š. Rückl, and P. Zeman for their earlier contributions to the implementation of SELAP's dataset.

Bibliography

- Blackwell, N.G. (2011). *Middle and Late Bronze Age metal tools from the Aegean, Eastern Mediterranean, and Anatolia: Implications for cultural/regional interaction and craftsmanship*. PhD diss. Bryn Mawr College.
- Bourdieu, P. (1977). *Outline of a theory of practice*. Cambridge University Press.
- Buchholz, H.-G. (1962). Der Pfeilglatter aus dem VI. Schachtgrab von Mykene und die helladischen Pfeilspitzen. *Jahrbuch des Deutschen Archäologischen Instituts*, 77, 1-58.
- Dornan, J.L. (2002). Agency and archaeology: Past, present, and future directions. *Journal of Archaeological Method and Theory*, 9.4, 303-329.
- French, E.B. (1971). The development of Mycenaean terracotta figurines. *Annual of the British School at Athens*, 66, 101-187.
- Furumark, A. (1941a). *Mycenaean pottery, I. Analysis and classification*. Svenska Institutet i Athen.
- Furumark, A. (1941b). *Mycenaean pottery, II. Chronology*. Svenska Institutet i Athen.
- Giddens, A. (1993). *New rules of sociological method*. Stanford University Press.
- Guarnaccia, P.J., & Hausmann-Stabile C. (2016). Acculturation and its Discontents: A case for bringing anthropology back into the conversation. *Sociology and Anthropology*, 4.2, 114-124.
- Haggis, D., & Antonaccio, C.M. (2015). A Contextual Archaeology of Ancient Greece. In D. Haggis & C.M. Antonaccio (eds.) *Classical Archaeology in Context: Theory and practice in excavation in the Greek World* (pp. 1-20). Walter de Gruyter Inc.
- Hodder, I. (2012). *Entangled: An archaeology of the relationships between humans and things*. Wiley.
- Hope Simpson, R., & Lazenby, J.F. (1970). Notes from the Dodecanese II. *Annual of the British School at Athens*, 65, 47-76.
- Kilian, K. (1988). Mycenaean Up to Date. Trends and Changes in Recent Research. In E.B. French & K.A. Wardle (eds.) *Problems in Greek Prehistory. Papers presented at the centenary conference of the British School of Archaeology at Athens* (115-152). Bristol Classical Press.
- Kilian-Dirlmeier, I. (1993). *Die Schwerter in Griechenland (ausserhalb der Peloponnes), Bulgarien und Albanien*. Steiner, Stuttgart.
- Konstantinidi, E.M. (2001). *Jewellery revealed in the burial contexts of the Greek Bronze Age*. BAR -International Series: Vol. 912. Archaeopress.

- Kramer, E.M. (2019). Cultural fusion theory. *Oxford University Research Encyclopedia of Communication*. Oxford University Research Encyclopedia.
- Laurenzi, L. (1936). Attività del servizio archeologico nelle isole italiane dell'Egeo nel biennio 1934-1935. *Bollettino d'arte*, 30, 129-148.
- Lemos, I.S. (2002). *The Protogeometric Aegean*. Oxford University Press.
- Marketou, T. (1990a). Asomatos and Serraglio. Early Bronze Age production and interconnections. *Hydra*, 7, 40-49.
- Marketou, T. (1990b). Santorini Tephra from Rhodes and Kos. Some Chronological Remarks based on the Stratigraphy In D.A. Hardy & A.C. Renfrew (eds.) *Thera and the Aegean World III. Proceedings of the 3rd international scientific congress, Santorini, Greece, 3-9 September 1989* (pp. 100-113). The Thera Foundation.
- Marketou, T. (2004). Η Πρώμη Εποχή του Χαλκού στην Κω. In A. Giannikouri, I. Zerboudaki, I. Kollias, I. Papachristodoulou (eds.) *Χάρis Χαίρε: Μελέτες στη μνήμη της Χάρης Κάντζια* (pp. 17-37). Αρχαιολογικό Ινστιτούτο Αιγαϊακών Σπουδών.
- Marketou, T. (2010). Dodecanese. In E.H. Cline (ed.) *The Oxford Handbook of the Bronze Age Aegean (ca. 3000-1000 BC)* (pp. 762-774). Oxford University Press.
- McNamee, C., Sullivan III, A.P., Marketou, T., Vitale, S., & Michailidou, M. (2021). Managing environmental challenges with anthropogenic bedrock modification: Archaeological survey evidence from the Upper Basin (USA) and the island of Kos (Greece). *Quaternary International*, 597, 76-86.
- McNamee, C., & Vitale, S. (2020). Langada Revisited: Construction Practices, Space, and Sociocultural Identity in the Koan Burial Arena during the Mycenaean Palatial and Postpalatial Periods. In J.M.A. Murphy (ed.) *Death in Late Bronze Age Greece: Variations on a theme* (pp. 214-247). Oxford University Press.
- Mokrišová, J. (2016). Minoanisation, Mycenaeanisation, and Mobility: A View from Southwest Anatolia, in E. Gorogianni, P. Pavúk, & L. Girella (eds.) *Beyond Thalassocracies. Understanding processes of Minoanisation and Mycenaeanisation in the Aegean* (pp. 43-57). Oxbow Books.
- Morricone, L. (1967). Eleona e Langada: Sepolcreti della tarda Età del Bronzo a Co. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 43-44, 5-311.
- Morricone, L. (1975). Co – scavi e scoperte nel “Serraglio” e in località minori (1935-1943). *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 50-51, 139-396.
- Morricone, L. (1982). Sepolture della prima Età del Ferro a Co. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 61, 9-427.
- Mountjoy, P. (1986). *Mycenaean decorated pottery: A guide to identification*. Paul Åströms Förlag.
- Mountjoy, P. (1999). *Regional Mycenaean Decorated Pottery*. Verlag Marie Leidorf GmbH.
- Nani, F., Vitale, S., & McNamee, C. Forthcoming. Built environments, funerary landscapes, and cultural transitions on Kos: The “Serraglio”, Eleona, and Langada during the Late Bronze and Early Iron Ages. *Studi Micenei ed Egeo-Anatolici, Nuova Serie*, 10.
- Palmieri, M.G. (2015). Protogeometric and Geometric Pottery from the Kos Early Iron Age Necropolis Revisited. Some Features of the Local Ceramic Production. In P.M. Militello & H. Önz (eds.) *SOMA 2011: Proceedings of the 15th Symposium on Mediterranean Archaeology, held at the University of Catania 3-5 March 2011* (pp. 135-141). *BAR -International Series: Vol. 2695*. Archaeopress.
- Podzuweit, C. (2007). *Studien zur spätmykenischen Keramik*. Reichert Verlag.
- Rutter, J.B. (1995). *Lerna: A Preclassical site in the Argolid*, 3. *The Pottery of Lerna IV*. The American School of Classical Studies at Athens.
- Sanders, N.K. (1963). Later Aegean bronze swords. *American Journal of Archaeology*, 67, 117-153.
- Schönfeld, G. (1988). Bericht zur bemalten mykenischen Keramik. Ausgrabungen in Tiryns 1982/83. *Archäologischen Anzeiger*, 1988, 153-211.

- Stockhammer, P. (2012) Conceptualizing Cultural Hybridization in Archaeology. In P. Stockhammer (ed.) *Conceptualizing Cultural Hybridization: A transdisciplinary approach. Papers of the conference, Heidelberg, 21st-22nd September 2009* (pp. 43-58). Springer.
- Vitale, S. (2006). L'insediamento di "Serraglio" durante il Tardo Bronzo. Riesame dei principali contesti portati alla luce da Luigi Morricone tra il 1935 ed il 1946. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 83, 71-94
- Vitale, S. (2012). Serraglio, Eleona, and Langada Archaeological Project (SELAP): Report on the results of the 2009 and 2010 study seasons. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 87, 1233-1252.
- Vitale, S. (2013). The Asklopis Reconsidered: A preliminary report on the chronology and burial practices of an Early Bronze Age 2 cemetery on Kos. *Aegean Archaeology*, 10, 47-63.
- Vitale, S. (2017). The Koan Ceramic Assemblage during the Late Bronze Age: Classification, Chronology, Typology, and Significance. In P. Triantafyllidis (ed.) Το Αρχαιολογικό Έργο στα Νησιά του Αιγαίου. Διεθνές Επιστημονικό Συνέδριο. Ρόδος, 27 Νοεμβρίου-1 Δεκεμβρίου 2013, Mitilini (pp. 151-174). Υπουργείο Πολιτισμού και Αθλητισμού.
- Vitale, S. (2018). *Le classi ceramiche della "tradizione mista" a Kos nel Tardo Bronzo IA*. Archaeopress Publishing Ltd.
- Vitale, S. (2021). 'Turn and Face the Strain': Continuity and Change on Kos during the Mycenaean Late Palatial and Early Post-Palatial Periods. In R. Jung (ed.) *Punta di Zambrone I. 1200 BCE – A Time of Breakdown, a Time of Progress in Southern Italy and Greece* (pp. 527-560). OREA 17. Austrian Academy of Sciences.
- Vitale, S. (2023a). Social Place and Space on Early Late Bronze Age Kos: The Burial Arena of Eleona and the Making of Mycenaean Identity in the SASCAR. In F. Fabiani, S. Genovesi & F. Ghizzani Marcía (eds.) *Costruire gli spazi dell'aggregazione. Le dinamiche del confronto dall'Antichità al Medioevo* (pp. 7-37). Pisa University Press.
- Vitale, S. (2023b). The Late Bronze Age to Early Iron Age transition on Kos: A preliminary report on "new" and old data from the "Serraglio", Eleona, and Langada. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 101, 58-78.
- Vitale, S. (2024). The Late Bronze Age to Early Iron Age chronological sequence from the site of the Asklopis in the northeast Koan region. *OCNUS Quaderni della Scuola di Specializzazione in Beni Archeologici*, 32, 27-41.
- Vitale, S., Marketou, T., McNamee, C., Ballan, E., Blackwell, N.G., Iliopoulos, I., Mantello, C., Morrison, J.E., Moulo, K., Moutafi, I., Passa, K.-S., & Vika, E. (2017). Serraglio, Eleona, and Langada Archaeological Project (SELAP): Report on the results of the 2011 to 2015 study seasons. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 94, 225-285.
- Vitale, S., Marketou, T., McNamee, C., & Michailidou, M. (2021). The Kos Archaeological Survey Project and the site of Ayios Panteleimon in the northeast Koan region. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 99, 108-142.
- Vitale, S., McNamee, C., & Dudlik, K. (2022a). Koan Mycenaean Identity in the Late Bronze Age: A Theoretical Summary. In S. Vitale (ed.) ΑΙΓΑΙΟΣ. *Studi sul Mediterraneo antico presentati a Giampaolo Graziadio* (pp. 151-174). ΑΓΩΓΗ, *Atti della Scuola di Specializzazione in Beni Archeologici, Università di Pisa*, 14-18. Pisa University Press.
- Vitale, S., & Morrison, J. (2017). Food and Cultural Identity on Kos during the Bronze Age: A Typological, Technological, and Macroscopic Fabric Analysis of the Storage and Cooking Pottery Assemblage. In J.A. Hruba & D.A. Trusty (ed.) *From Cooking Vessels to Cultural Practices in the Late Bronze Age Aegean* (pp. 72-97). Oxbow Books.
- Vitale, S., & Morrison, J. (2018). The Final Neolithic and Early Bronze Age pottery from the Site of the Asklopis in the northeast koan region. *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente*, 95, 39-64.

- Vitale, S., Nani, F., & McNamee, C. (2023). Building identities: Breaks and continuity in construction practices at the Late Bronze Age settlement of the “Serraglio” on Kos. *Studi Classici e Orientali*, 69, 11-37.
- Vitale, S., & Querci, A. (2024). Ships, routes, and connectivity: Seafaring technology and the making of the early Late Bronze Age Aegean. *Thiasos. Rivista di archeologia e architettura antica*, 13, 435-446.
- Vitale, S., Stocker, S.R., & Davis, J.L. (2022b). The Destructions of the Palace of Nestor at Pylos and Its LH IIIA Predecessor as a Methodological Case Study. In R. Jung & E. Kardamaki (ed.) *Synchronizing the Destructions of the Mycenaean Palaces* (pp. 121-148). *Mykenische Studien*, 36. Austrian Academy of Sciences.

ArcheoLogica Data

N° 5.2 – 2025

ArcheoLogica Data wants to reach an Italian and international audience of scholars, professionals, students, and, more generally, early-career archaeologists, and it accepts contributions written both in Italian and English.

ArcheoLogica Data proposes to indissolubly associate data and interpretation. It embraces that global idea of archaeological data that integrates all the discipline declinations without any thematic or chronological constraints. Data is at the centre, and around lies everything that can stem from it: interpretations, hypotheses, reconstructions, applications, theoretical and methodological reflections, critical ideas, constructive discussions.

€ 32,00

ISSN 2785-0307
e-ISSN 2785-0668
ISBN 978-88-9285-386-7
e-ISSN 978-88-9285-387-4

ALD-5-2-2025



ArcheoLogica Data

N° 5.2 – 2025

All'Insegna del Giglio

Open Access Annual Journal

ald

N° 5.2 – 2025

Archeo Logica Data

