

The socioeconomic dynamics of settling down

Edited by

Gary M. Feinman and Victor D. Thompson

Published in

Frontiers in Human Dynamics



FRONTIERS EBOOK COPYRIGHT STATEMENT

The copyright in the text of individual articles in this ebook is the property of their respective authors or their respective institutions or funders. The copyright in graphics and images within each article may be subject to copyright of other parties. In both cases this is subject to a license granted to Frontiers.

The compilation of articles constituting this ebook is the property of Frontiers.

Each article within this ebook, and the ebook itself, are published under the most recent version of the Creative Commons CC-BY licence. The version current at the date of publication of this ebook is CC-BY 4.0. If the CC-BY licence is updated, the licence granted by Frontiers is automatically updated to the new version.

When exercising any right under the CC-BY licence, Frontiers must be attributed as the original publisher of the article or ebook, as applicable.

Authors have the responsibility of ensuring that any graphics or other materials which are the property of others may be included in the CC-BY licence, but this should be checked before relying on the CC-BY licence to reproduce those materials. Any copyright notices relating to those materials must be complied with.

Copyright and source acknowledgement notices may not be removed and must be displayed in any copy, derivative work or partial copy which includes the elements in question.

All copyright, and all rights therein, are protected by national and international copyright laws. The above represents a summary only. For further information please read Frontiers' Conditions for Website Use and Copyright Statement, and the applicable CC-BY licence.

ISSN 1664-8714
ISBN 978-2-8325-6869-9
DOI 10.3389/978-2-8325-6869-9

Generative AI statement

Any alternative text (Alt text) provided alongside figures in the articles in this ebook has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

About Frontiers

Frontiers is more than just an open access publisher of scholarly articles: it is a pioneering approach to the world of academia, radically improving the way scholarly research is managed. The grand vision of Frontiers is a world where all people have an equal opportunity to seek, share and generate knowledge. Frontiers provides immediate and permanent online open access to all its publications, but this alone is not enough to realize our grand goals.

Frontiers journal series

The Frontiers journal series is a multi-tier and interdisciplinary set of open-access, online journals, promising a paradigm shift from the current review, selection and dissemination processes in academic publishing. All Frontiers journals are driven by researchers for researchers; therefore, they constitute a service to the scholarly community. At the same time, the *Frontiers journal series* operates on a revolutionary invention, the tiered publishing system, initially addressing specific communities of scholars, and gradually climbing up to broader public understanding, thus serving the interests of the lay society, too.

Dedication to quality

Each Frontiers article is a landmark of the highest quality, thanks to genuinely collaborative interactions between authors and review editors, who include some of the world's best academicians. Research must be certified by peers before entering a stream of knowledge that may eventually reach the public - and shape society; therefore, Frontiers only applies the most rigorous and unbiased reviews. Frontiers revolutionizes research publishing by freely delivering the most outstanding research, evaluated with no bias from both the academic and social point of view. By applying the most advanced information technologies, Frontiers is catapulting scholarly publishing into a new generation.

What are Frontiers Research Topics?

Frontiers Research Topics are very popular trademarks of the *Frontiers journals series*: they are collections of at least ten articles, all centered on a particular subject. With their unique mix of varied contributions from Original Research to Review Articles, Frontiers Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area.

Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers editorial office: frontiersin.org/about/contact

The socioeconomic dynamics of settling down

Topic editors

Gary M. Feinman — Field Museum of Natural History, United States

Victor D. Thompson — University of Georgia, United States

Citation

Feinman, G. M., Thompson, V. D., eds. (2025). *The socioeconomic dynamics of settling down*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-6869-9

Table of contents

04	Editorial: The socioeconomic dynamics of settling down Gary M. Feinman and Victor D. Thompson
07	Settling down in Southwest Asia: the Epipalaeolithic-Neolithic transformation Trevor Watkins
12	Settling down at Ceibal and Cuello: variation in the transition to sedentism across the Maya lowlands Jessica MacLellan
29	The social-ecological landscape of herding on the high mountain commons of Larrau in the western Pyrenees (France) Ted L Gragson and Michael R. Coughlan
51	Settling down with anthropomorphic clay figurines in eastern North America G. Logan Miller
64	Sequential villages and settling down on the southeast U.S. coast Rachel Cajigas, Matthew C. Sanger, Anna M. Semon, Victor D. Thompson, Carey J. Garland, Elliot H. Blair and David Hurst Thomas
77	The oyster revolution: shell middens, shell temper, and settling down in North America's Chesapeake region Jessica A. Jenkins and Martin D. Gallivan
91	Settlement ecology of Bronze Age Transylvania Colin P. Quinn
105	Common animals: sedentary pastoralism and the emergence of the commons as an institution Katherine Kanne, Mark Haughton and Ryan Lash
127	The process of nucleation amongst the early cities of central Italy in the first millennium BC Simon Stoddart, Emily M. Breslin, Carmen Esposito, Fanny Gavériaux, Gianbattista Marras, Rowan McLaughlin, Laura Motta, Ornella Prato, Frijda Schmidt and Camilla Zeviani



OPEN ACCESS

EDITED AND REVIEWED BY
Dusan Boric,
Sapienza University of Rome, Italy

*CORRESPONDENCE
Gary M. Feinman
✉ gfeinman@fieldmuseum.org

RECEIVED 30 May 2025
ACCEPTED 30 June 2025
PUBLISHED 10 July 2025

CITATION
Feinman GM and Thompson VD (2025)
Editorial: The socioeconomic dynamics of
settling down. *Front. Hum. Dyn.* 7:1638264.
doi: 10.3389/fhumd.2025.1638264

COPYRIGHT
© 2025 Feinman and Thompson. This is an
open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](#). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic practice.
No use, distribution or reproduction is
permitted which does not comply with these
terms.

Editorial: The socioeconomic dynamics of settling down

Gary M. Feinman^{1*} and Victor D. Thompson²

¹MacArthur Curator of Anthropology, Negaunee Integrative Research Center, Field Museum of Natural History, Chicago, IL, United States, ²Georgia Museum of Natural History, Laboratory of Archaeology, University of Georgia, Athens, GA, United States

KEYWORDS

nucleation, sedentism, domestication, agriculture, mobility, institutions, population, foraging

Editorial on the Research Topic
[The socioeconomic dynamics of settling down](#)

Introduction

Since the dawn of academic anthropology and archaeology, two centuries ago (e.g., [Morgan, 1877](#)), the advent of farming has been positioned as a “revolutionary” juncture in human history ([Childe, 1936](#)). Early theories linked the origins of agriculture to a subsequent process of settling down in more permanent communities (e.g., [White, 1949](#)). Researchers viewed the expansion of food surpluses, underpinned by domestication, as the preeminent causal role in a transformational process that was presumed to have global pertinence, kick-starting a linear progressive stepped path to larger and ultimately urban environments ([Childe, 1950](#)). An early stage in this presumed process was generally seen as small, autonomous, sedentary, and largely isolated agrarian communities ([Carneiro, 1970](#)) that only later were “pushed” by Malthusian forces or “pulled” by self-serving aggrandizers into larger, more unequal, and autocratic political formations (e.g., [Boserup, 1965](#)).

Although increments of knowledge from a multitude of disciplines have served to refine and widen our models and constructs (e.g., [Zeder and Smith, 2009](#)), core foundational pillars rooted in nineteenth century postulations (e.g., [Morgan, 1877](#)) continue to hold implicit sway across the social sciences and among the broader educated public. Here through comparative consideration of a series of case studies in conjunction with other published literature, we draw on new archaeological and historical findings, enriched by decades of field and laboratory analyses, to reflect critically on these long-entrenched views. We find that the key transitions in subsistence, settlement, institutions, and behavioral practices that occurred across six continents after 15,000 BCE were neither unilinear, uniform, or necessarily set in motion by climate change or technological shifts in food production ([Feinman, 2013](#); [Kerig et al., 2025](#); cf. [Boone and Alsgaard, 2024](#); [Dow and Reed, 2015](#)).

Diverse paths and processes

The manuscripts in this thematic collection serve as empirically grounded challenges to long-held categorical and transformational tropes. Collectively, they illustrate the great

diversity in the processes of settling down, which occurred initially in many regions of the world without domesticates (Cajigas et al.; Jenkins and Gallivan; Watkins). Likewise, several of these papers illustrate that even as settlements became more permanent, individual mobility continued and long-distance intercommunity networks thrived (Gragson and Coughlan; Jenkins and Gallivan). In two cases (Gragson and Coughlan; Kanne et al.), domesticated animals were integral to the establishment of permanent communities, with little direct subsistence reliance on plant-based agriculture.

A recurrent theme across these manuscripts (MacLellan; Miller; see also Feinman and Neitzel, 2023) is that the process of settling down, the transition to more sedentary lifeways, always involves much more than human–environmental or people–food equations or task groups (Kaplan et al., 2009). Cooperation is difficult to maintain, even in small groups, and settling down generally meant greater degrees of social interaction with larger numbers of people. People are selfish, have agency, and have the cognitive ability to problem solve and change. At the same time, they also are the most cooperative species on the planet with non-kin—both in terms of the scale of cooperation and the range of tasks that are implemented collaboratively. The juxtaposition of these seeming contradictory characteristics form the basis by which the fragile dynamics of cooperation emerge, while also laying the groundwork for durable institutions based on these initial venues of cooperation (Holland-Lulewicz et al., 2020).

Socioeconomic dynamics of settling down

Cognitive constraints limit the number of people that we can know on a face to face or biographical basis to a few hundred (Dunbar, 2008). When people reside in one place for stretches of time, they often make individual or cooperative investments in dwellings, ceremonial spaces, or the landscape, thereby diminishing their incentives to leave (Thompson, 2023). Such cooperative endeavors necessarily raise collective action dilemmas and free-riding, which revolve around a suite of issues including access, the etiquette of sharing, facility maintenance, dispute resolution, or collaborative participations (e.g., Wiessner, 2019). Greater scales and intensities of interaction generally provoke scalar stress (Watkins; Johnson, 1982), or what might be thought of as higher densities of and more intricate and diverse collective action challenges.

To retain their access to investments and help maintain cooperative networks, during the process of settling down, people often forge new institutions and innovations to foster cooperation, address free-riding, and leverage the economies of scale from pooled labor. The products of such innovations have been described as “energized crowding” (Smith, 2019) or the consequences of scaling (Bettencourt, 2013). Yet these changes, whether in the form of ceramic vessel technologies (Cajigas et al.), clay figurines (Miller), or ceremonial spaces (MacLellan; Watkins), take markedly different forms in distinct contexts. In some instances (Miller; Watkins) investments in ritual spaces preceded more permanent residential structures;

in others more permanent residential spaces were established before dedicated ritual spaces (Cajigas et al.). For the Maya, each of these patterns or architectural investment was evidenced in different regions (MacLellan). Alternatively, the herders of the western Pyrenees devised social agreements to manage cooperative land use before those collaborative arrangements materialized in more permanent settlements (Gragson and Coughlan).

Implications and prospect

Across these cases, we also see no evidence for linear, uniform, or progress-driven paths of long-term change. For most cases discussed, a time of settling down was followed by an episode of settlement movement, dispersion, or transition (e.g., Cajigas et al.; Quinn; Stoddart et al.). In other words, cooperation is fragile (Blanton and Fargher, 2016), and people often opted out even given their investments in architecture, landscape, and institutions. In this set of studies, the reasons for settlement abandonment only rarely seem to be a direct consequence of people-food equations; they more often reflect socioeconomic dynamics at community, regional, or even macroregional scales (Feinman and Neitzel, 2023).

In sum, these essays collectively serve to confront models that often are still rooted in a homogenized, linear past, and to raise new questions that challenge us to come up with analytical frames and mechanisms that help account for variation and change (e.g., Feinman, 2023), rather than continue to pursue the futile search for a uniform past that never actually existed. Through these cases as well as others (e.g., Feinman et al., 2025; Feinman and Neitzel, 2023), we have documented that history, institutions, and agency matter. Only by bringing these considerations earlier and more directly into the explanatory process will we be able to understand why and how the process of settling down, though generally important, had different implications and outcomes across the globe.

Author contributions

GF: Writing – original draft, Writing – review & editing, Conceptualization. VT: Writing – original draft, Writing – review & editing, Conceptualization.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. Principal funding for this effort was provided by the Field Museum of Natural History, the University of Georgia, Laboratory of Archaeology, and the Georgia Museum of Natural History.

Acknowledgments

We are grateful to the contributors to this FHD Topic and to external reviewers who helped us refine the arguments in each

of the manuscripts. We thank Linda M. Nicholas for editorial assistance on the editorial and Rachael Benson (Frontiers) for her help handling the manuscripts.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

References

- Bettencourt, L. M. A. (2013). The origins of scaling in cities. *Science* 340, 1438–1441. doi: 10.1126/science.1235823
- Blanton, R. E., and Fargher, L. F. (2016). *How Humans Cooperate: Confronting the Challenges of Collective Action*. Boulder, CO: University Press of Colorado.
- Boone, J. L., and Alsgaard, A. (2024). Surf & turf: the role of intensification and surplus production in the development of social complexity in coastal & terrestrial habitats. *J. Anthropol. Archaeol.* 73:101566. doi: 10.1016/j.jaa.2023.101566
- Boserup, E. (1965). *The Conditions of Agricultural Growth*. London: George Allen and Unwin.
- Carneiro, R. L. (1970). A theory of the origin of the state. *Science* 169, 733–738. doi: 10.1126/science.169.3947.733
- Childe, V. G. (1936). *Man Makes Himself*. London: Watts and Co.
- Childe, V. G. (1950). The urban revolution. *Town Planning Rev.* 21, 3–17. doi: 10.3828/tpr.21.1.k853061t614q42qh
- Dow, G. K., and Reed, C. G. (2015). The origins of sedentism: Climate, population, and technology. *J. Econ. Behav. Organizat.* 119, 56–71. doi: 10.1016/j.jebo.2015.07.007
- Dunbar, R. I. M. (2008). Cognitive constraints on the structure and dynamics of social networks. *Group Dynamics: Theory, Research, and Practice* 12, 7–16. doi: 10.1037/1089-2699.12.1.7
- Feinman, G. M. (2013). “The emergence of social complexity: why more than population size matters,” in *Cooperation & Collective Action: Archaeological Perspectives*, ed. D. M. Carballo (Boulder, CO: University Press of Colorado), 35–56.
- Feinman, G. M. (2023). Reconceptualizing archaeological perspectives on long-term political change. *Annual Rev. Anthropol.* 52, 347–365. doi: 10.1146/annurev-anthro-060221-114205
- Feinman, G. M., Cervantes Quequezana, G., Green, A., Lawrence, D., Munson, J., Ortman, S., et al. (2025). Assessing grand narratives of economic inequality over time. *Proc. Nat. Acad. Sci.* 122:e2400698121. doi: 10.1073/pnas.2400698121
- Feinman, G. M., and Neitzel, J. E. (2023). The social dynamics of settling down. *J. Anthropol. Archaeol.* 69:101468. doi: 10.1016/j.jaa.2022.101468
- Holland-Lulewicz, J., Conger, M., Birch, J., Kowalewski, S., Jones, T. (2020). An institutional approach for archaeology. *J. Anthropol. Archaeol.* 58:101163. doi: 10.1016/j.jaa.2020.101163
- Johnson, G. A. (1982). “Organizational structure and scalar stress,” in *Theory and Explanation in Archaeology*, eds. C. Renfrew, M. J. Rowlands, and B. A. Segraves (New York: Academic Press), 389–421.
- Kaplan, H. S., Hooper, P. L., and Gurven, M. (2009). The evolutionary and ecological roots of human social organization. *Philos. Trans. Royal Soc. B.* 364, 3289–3299. doi: 10.1098/rstb.2009.0115
- Kerig, T., Crema, E. R., Birch, J., Feinman, G. M., Green, A. S., Gronenborn, D., et al. (2025). 100 generations of wealth equality after the Neolithic transitions. *Proc. Nat. Acad. Sci.* 122:e2400697122. doi: 10.1073/pnas.2400697122
- Morgan, L. H. (1877). *Ancient Society*. New York: World Publishing.
- Smith, M. E. (2019). “Energized crowding and the generative role of settlement, aggregation, and urbanization,” in *Coming Together: Comparative Approaches to Population Aggregation and Early Urbanization*, ed. A. Gyucha (Albany: State University of New York Press), 37–58.
- Thompson, V. D. (2023). Considering ideas of collective action, institutions, and ‘hunter-gatherers’ in the American Southeast. *J. Archaeol. Res.* 31, 503–560. doi: 10.1007/s10814-022-09179-3
- White, L. (1949). “Energy and the evolution of culture,” in *The Science of Culture*, ed. L. White (Grove: New York), 363–393.
- Wiessner, P. (2019). Collective action for war and for peace: a case study among the Enga of Papua, New Guinea. *Curr. Anthropol.* 60, 224–244. doi: 10.1086/702414
- Zeder, M. A., and Smith, B. D. (2009). A conversation on agricultural origins: talking past each other in a crowded room. *Curr. Anthropol.* 50, 681–691. doi: 10.1086/605553

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.



OPEN ACCESS

EDITED BY

Victor D. Thompson,
University of Georgia, United States

REVIEWED BY

Melinda Zeder,
Smithsonian Institution, United States

*CORRESPONDENCE

Trevor Watkins
✉ t.watkins@aed.ac.uk

RECEIVED 29 June 2023

ACCEPTED 31 July 2023

PUBLISHED 14 August 2023

CITATION

Watkins T (2023) Settling down in Southwest Asia: the Epipalaeolithic-Neolithic transformation. *Front. Hum. Dyn.* 5:1250167. doi: 10.3389/fhumd.2023.1250167

COPYRIGHT

© 2023 Watkins. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Settling down in Southwest Asia: the Epipalaeolithic-Neolithic transformation

Trevor Watkins*

School of History, Classics and Archaeology, University of Edinburgh, Edinburgh, United Kingdom

Permanent settlement began in southwest Asia across the end of the Pleistocene (the Epipalaeolithic) and the beginning of the Holocene (the Neolithic). Aggregation represents a transformation of the cultural niche, involving major social and cultural innovations and profound developments of the strategies of subsistence. At first, the scalar stress of living in large, permanent communities was diffused through corporate effort in the construction and maintenance of monumental communal buildings, a complex material symbolism, and increasing intensity of communal rituals; participation demonstrated commitment and conformity to community norms. As cultivated crops and managed herds of sheep and goat gradually became the predominant source of subsistence, the old sharing ethos was overtaken by the household as the central socio-economic unit; the household became the focus for ritual and symbolism. As population aggregations grew larger, their supra-regional networks of socio-economic sharing and exchange also became more complex, extensive and intensive. The new cultural niche based on networked aggregations produced a marked acceleration in both the rate of cultural accumulation and the rate of demographic growth. At the end of the Neolithic, plow-agriculture began in place of horticulture; there are the first signs of mixed agro-pastoral economies, the marking of private property, new technologies (ceramics and copper metallurgy), and, in southern Iraq, irrigation agriculture. At this time, too, the accelerating expansion of the population of farmers is marked by the appearance of their new settlements in all directions.

KEYWORDS

aggregation, cultural niche construction, sedentism, scalar stress, domestication of plants and animals, socio-economic networks, Neolithic, Epipalaeolithic

Introduction

This paper sets the cultural-social-economic transformation that occurred between 23,000 and 8,000 BP in southwest Asia in the context of the long term of human cultural evolution. Cultural niche construction theory provides the foundations for the argument of this paper. While the cultural niche may be pushed into adaptations by exogenous factors, it is well able to evolve of itself. Looking at the overall process of human cultural evolution, leading cultural evolutionary theorists such as Sterelny (2011), Henrich (2015), and Laland (2017) have shown how the evolution of the human cultural niche is characterized by the intense positive feedback loops between elements of the niche, its capacity to ensure the intergenerational transfer of increasingly complex cultural packages in parallel with the increasing scale of human social groups. Henrich (2015, p. 57) concludes that, from an early stage in the human evolutionary story, “cultural evolution became the

primary driver of our species' genetic evolution". Laland highlights "the significance of accelerating cycles of evolutionary feedback, whereby an interwoven complex of cultural processes reinforce each other in an irresistible runaway dynamic" (Laland, 2017, p. 3).

The basic claim that underpins this paper is that the emergence of permanent aggregation represents a powerful inflection point in the graph of accelerating cultural, social, demographic and economic evolution: it imparts a distinct acceleration to the rate of cultural, social and economic change (Sterelny and Watkins, 2015). The earliest known example of that transformation of the cultural niche occurred in southwest Asia across the end of the Pleistocene (in archaeological terms the Epipalaeolithic) and the beginning of the Holocene (the Neolithic). The formation of aggregations replaced the age-old mobile forager strategies, involving profound social and cultural adaptations and equally profound developments of the strategies of subsistence economics (often referred to as "the origins of agriculture"). Throughout, or at least until recently, the trigger for this major transformation has been thought of in simplistic evolutionary terms, whereby an external, exogenous, environmental factor such as climate change provoked cultural adaptations.

Unfolding in four stages

The transformation of the cultural niche in southwest Asia can be summarized in four stages, the first of which begins around 23,000 BCE, in the heart of the Last Glacial Maximum, and continues for about nine millennia. The transformation began within a zone that has been labeled the hilly flanks of the Fertile Crescent, an arc of relatively well-watered hill-country from Israel, the Palestinian territories, and Jordan, through Lebanon and western Syria, turning eastwards through southeast Türkiye, across north Iraq, and the Zagros piedmont and intermontane valleys along the Iraq-Iran border. For more than 70 years most field research has been focused within that arc; the transformation process is now beginning to be found and documented in parts of central Anatolia, and the island of also Cyprus has a surprising part to play.

The first phase covers most of the Epipalaeolithic period. By contrast with the Upper Paleolithic period, the number of sites in the Epipalaeolithic rapidly increases, and the degree of mobility of forager groups reduces. At the boundary between the Upper Paleolithic and the beginning of the Epipalaeolithic periods, at Ohalo II in north Israel a group of hunter-gatherers stayed seasonally, possibly throughout the year, at an ecotone location from which a wide range of different food resources were on hand (Nadel and Werker, 1999; Nadel, 2017). They harvested a wide range of grasses and wild cereals. The Ohalo research team has suggested that these wild cereals were beginning to be tended and cultivated (Nadel et al., 2012; Snir et al., 2015a,b). Later in this first period, in seasonal wetland areas within the semi-arid of north Jordan, several "aggregation sites" have been identified, where very large numbers of hunter-gatherer groups gathered in seasons of plenty. The deposit at the site of Kharaneh IV, for example, is up to 2 m thick, and extends to more than 21,000 square meters (Maher, 2010; Macdonald and Maher, 2022).

The beginning of permanent settlements

The second phase includes the last part of the Epipalaeolithic and the earliest Neolithic (Pre-Pottery Neolithic A), approximately 14,000 and 8,500 BCE. In this phase populations became fully sedentary, living in what seem to us to be small settlements that nevertheless, by contrast with earlier periods, represent people living together in larger numbers in permanently co-resident societies. How to understand late Epipalaeolithic settlement sites such as Eynan in north Israel, where there is a stratigraphic succession of permanent buildings that in total cover >2,000 years, remains to be resolved (Valla and Bocquentin, 2009; Valla et al., 2017). Is it possible that what looks like a permanent settlement of successively rebuilt stone houses was continuously occupied throughout that length of time? Whether in the late Epipalaeolithic or the early Pre-Pottery Neolithic, the sedentary way of life in a permanent settlement depended on hunting and gathering within the territory immediately around the settlement; the broad-spectrum strategy was occasioned more by the needs of a sedentary population than being enforced by the reduced availability of large ungulates. The evidence now shows that these communities were engaged in pre-domestication cultivation (Willcox, 2012), managing crops of both cereals (primarily wheat and barley) and legumes (notably pulses such as lentils and chickpeas).

Across the whole of the Epipalaeolithic-Neolithic transformation there were dramatic shifts in world climate, although the evidence for the local impact of global climate change varies considerably. Nevertheless, the rapid amelioration of climate at the beginning of the Holocene, around 9,500 BCE, may well have encouraged the proliferation of permanent settlements around the hilly flanks and in central Anatolia. Coming together to live in permanent settlements required the greater implementation of ritual activities and the construction of large and elaborate communal buildings, for example at Jerf el Ahmar in north Syria (Stordeur et al., 2000; Stordeur, 2015). The communal buildings of Jerf el Ahmar, like those of the more famous site of Göbekli Tepe in southeast Türkiye, are associated with sculpted stone stelae, massive T-shaped anthropomorphic monoliths (in the case of Göbekli Tepe and other nearby settlements), and a complex shared vocabulary of symbolic imagery. The burial of their dead in places where they had lived was a practice that had begun as far back as the late Middle Paleolithic. In the later Epipalaeolithic there are sites with clusters of elaborate burials under buildings. In the early Pre-Pottery Neolithic there is a range of burial practice within the permanent settlements. Along the Tigris valley in southeast Turkey, each settlement was different in terms of the numbers of intramural burials, with Körtiktepe topping the table with several hundred bodies buried below the floors of the houses (Benz et al., 2018).

The new, larger-scale societies needed new or enhanced social mechanisms to ensure social cohesion among numbers of people who were unrelated or not directly known to one another. Sterelny (2018, 2020) shows how the emergence of what he calls "articulated religion" involved the costly signaling of collective rituals within the linked stories of a mythology or ideology. In the larger and more complex network context of super-communities made

up of (relatively) large, sedentary communities, that articulation took the form of architectural symbolism, sculpture and iconic symbols (Watkins, 1990, 2004a,b). From another perspective, the new cultural niche required new social institutions that countered the increased stresses of living in sedentary communities and dampened the inevitable conflicts. Dunbar (2022) argues that the community-level institutions and rituals such as the creation, maintenance and use of communal buildings served to enhance the sense of belonging and community bonding.

“Mega-sites” and supercommunities

The third phase covers the later Pre-Pottery Neolithic period (~8,500–6,500 BCE). The size of co-resident communities grew, and, in a number of cases, there would have been many hundreds or several thousand people living together in settlements that have been called “mega-sites”. In some cases the growth of the population was too rapid to be simply the result of population growth; it has been suggested that the mega-sites were social environments that attracted more and more incomers. Despite the challenging scale of their populations, many sites of this period persisted for many centuries. There were significant economic (and therefore presumably social) changes from around 8,800–8,500 BCE; the communal buildings and shared storage came to an end, and the evidence for fully domesticated varieties of cereals and animals implies a significant upscaling in the investment in both cultivation and herding. In this phase the subsistence economy was increasingly dependent on hoe-agriculture of domesticated cereals and pulses and the herding of sheep and goat. Wild cattle were domesticated in a few places (Arbuckle, 2014), and were taken to Cyprus around 8,500 BCE (Vigne et al., 2023); cows for milking and oxen for plowing become significant in or after the fourth phase.

Social and cultural networking in the later Pre-Pottery Neolithic was both more intensive and more extensive, creating regionally extensive cultural super-communities (Watkins, 2008). One dimension of the complexity and intensity of networking has been explored through the distribution of central Anatolian obsidian throughout settlements in the Levant (Ibañez et al., 2015; Ortega et al., 2016). The obsidian statistics show the growth through time in the amounts in the network, standing as a proxy for its intensification. The exchange networks also became more complex and sophisticated with time. Communities tended to concentrate on building relations with larger settlements up to 180 km away. The ratio of obsidian (from sources hundreds of kilometers away) to flint (available locally) varied markedly in relation to settlement size, particularly in the later Pre-Pottery Neolithic. “Big” sites of that period are at least six times larger in area than “small” sites, but the “big” sites had 33 times more obsidian than the “small” sites that they served. The distribution is modeled in terms of “small-world” networking; and the results look like the effect of settlement scaling (cf. Lobo et al., 2020), whereby “productivity” or “wealth” increases with the scale of the settlement’s population in accordance with a super-linear exponent, as these larger settlements began to play a key role as hubs in regional social exchange networks.

At one level, each community attended to the needs of social cohesion and social bonding, resulting in the individual characteristics of each of them in the archaeological record. At the same time there were supra-regional “interaction spheres” within which these societies were actively engaged. The peer-polity interaction sphere model proposed by Renfrew (1986) seems appropriate: that is a kind of interaction sphere where all the participating communities show by their sharing and exchange that they shared the same values, while each had its own particular way of doing so. Renfrew emphasized the importance of “competitive emulation” within the interaction sphere. The things in the social exchange networks, such as obsidian, marine shells, figurines and decorated stone bowls had become standardized, a process that Renfrew calls “symbolic entrainment”. Inter-communal competition leading to conflict has been seen to be a risk, and inter-community warfare is not uncommonly encountered in the ethnographic literature. Archaeological examples of warfare in Neolithic contexts have been found across Europe, but not in the Neolithic of southwest Asia.

Intensification or dispersal

The fourth phase (7,000–6,000 BCE) starts with the end of the Pre-Pottery Neolithic and continues through what archaeologists consequently call the Pottery Neolithic. The large, classic later Pre-Pottery Neolithic settlements declined rapidly in size or were abandoned, and there was a spread of many, smaller, less densely built-up settlements across a much wider area. Communities by this time had reliable, if still simple, mixed farming practices, and they could expand into environments that were not practical for the earlier communities. Settlement within southwest Asia spread out beyond the hilly flanks and central Anatolia, implementing new adaptations as it extended into the drier tracts of inland Syria and Jordan, new farming strategies across the green Jezirah of north Mesopotamia, and new irrigation technology in the alluvial lands of southern Iraq and southwest Iran. At the end of the Neolithic domesticated cattle opened the way to extensive plow-agriculture in place of horticulture by hand. There are the first signs of mixed agro-pastoral economies, and the marking of private property.

By the end of the Neolithic there existed the potential for the accumulation of wealth, whether in real estate or flocks and herds, and heritable wealth is the foundation of social and economic inequality (Borgerhoff Mulder et al., 2009; Bogaard et al., 2019). The use of painted pottery spread throughout the whole region, signaling new ways of storing, preparing, cooking and—importantly—serving and sharing food. From 7,000 BCE there was expansion not only within the arc of the hilly flanks of the Fertile Crescent, but also an outward expansion, which is best documented in a westward direction, from northwest Anatolia into the Balkans, into the western Anatolian coastlands, the Aegean islands, and the Greek mainland—the beginning of an extraordinarily rapid expansion of farming population across Europe. From this point therefore there were two trajectories. Within the core of southwest

Asia the trajectory was toward intensification, diversification, and further acceleration of cultural accumulation (for example, dairy farming, plow agriculture, irrigation, metallurgy, textiles, ceramic mass-production). Beyond southwest Asia, for example across Europe, there was—for a time—almost limitless new land to exploit, and the new cultural niche was spread by the rapidly expanding population, adapting repeatedly to new environments (and, in some regions, reacting with indigenous foraging populations).

What is striking about the Epipalaeolithic-Neolithic transformation in southwest Asia is the acceleration in the tempo of cultural cumulation (innovation), and the parallel acceleration in the rate of population growth. Both cultural niche construction theory and settlement scaling theory would expect that, as population numbers and their social interconnectivity increased, so there should be an increase in the tempo of innovation. Thus the Epipalaeolithic-Neolithic transformation in southwest Asia established the new baseline conditions for the unprecedented rates of cultural and socio-economic evolution of later periods.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

References

- Arbuckle, B. S. (2014). Pace and process in the emergence of animal husbandry in Neolithic southwest Asia. *Bioarchaeol. Near East* 8, 53–81.
- Benz, M., Alt, K. W., Erdal, Y. S., Sahin, F. S., and Özkaya, V. (2018). “Re-presenting the Past: Evidence from Daily Practices and Rituals at Körtik Tepe,” in *Religion, History, and Place in the Origin of Settled Life*, Hodder, I. (ed.). Boulder: University Press of Colorado.
- Bogaard, A., Fochesato, M., and Bowles, S. (2019). The farming-inequality nexus: new insights from ancient Western Eurasia. *Antiquity* 93, 1129–1143. doi: 10.15184/aqy.2019.105
- Borgerhoff Mulder, M., Bowles, S., Hertz, T., Bell, A., Beise, J., Clark, G., et al. (2009). Intergenerational wealth transmission and the dynamics of inequality in small-scale societies. *Science* 326, 682–688. doi: 10.1126/science.1178336
- Dunbar, R. I. M. (2022). Managing the stresses of group-living in the transition to village life. *Evolut. Human Sci.* 4, e40. doi: 10.1017/ehs.2022.39
- Henrich, J. (2015). *The Secret of Our Success: How Culture Is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter*. Princeton: Princeton University Press. doi: 10.2307/j.ctvc77f0d
- Ibañez, J. J., Ortega, D., Campos, D., Khalidi, L., and Méndez, V. (2015). Testing complex networks of interaction at the onset of the Near Eastern Neolithic using modelling of obsidian exchange. *J. Royal Soc. Interf.* 12, 20150210. doi: 10.1098/rsif.2015.0210
- Laland, K. N. (2017). *Darwin's Unfinished Symphony: How Culture Made the Human Mind*. Princeton NJ: Princeton University Press. doi: 10.1515/9781400884872
- Lobo, J., Bettencourt, L. M. A., Ortman, S. G., and Smith, M. E. (2020). Settlement scaling theory: bridging the study of ancient and contemporary urban systems. *Urban Studies* 57, 731–747. doi: 10.1177/0042098019873796
- Macdonald, D. A., and Maher, L. A. (2022). Leaving home: technological and landscape knowledge as resilience at pre-Holocene Kharaneh IV, Azraq Basin, Jordan. *Holocene* 32, 1450–1461. doi: 10.1177/09596836221121784
- Maher, L. (2010). “People and their places at the end of the pleistocene: evaluating perspectives on physical and cultural landscape change,” in *Landscapes in Transition: Understanding Hunter-Gatherer and Farming Landscapes in the Early Holocene of Europe and the Levant*, Finlayson, B., and Warren, G. (eds.). London: Levant Supplementary Series & CBRL, 34–45.
- Nadel, D. (2017). “Ohalo II: A 23,000-year-old fisher-hunter-gatherer's camp on the shore of fluctuating Lake Kinneret (Sea of Galilee),” in *Quaternary Environments, Climate Change, and Humans in the Levant*, Bar-Yosef, O., and Enzel, Y. (eds.). Cambridge: Cambridge University Press, 291–294.
- Nadel, D., Piperno, D. R., Holst, I., Snir, A., and Weiss, E. (2012). New evidence for the processing of wild cereal grains at Ohalo II, a 23 000-year-old campsite on the shore of the Sea of Galilee, Israel. *Antiquity* 86, 990–1003. doi: 10.1017/S0003598X00048201
- Nadel, D., and Werker, E. (1999). The oldest ever brush hut plant remains from Ohalo II, Jordan Valley, Israel (19000 BP). *Antiquity* 73, 755–764. doi: 10.1017/S0003598X00065509
- Ortega, D., Ibanez, J. J., Campos, D., Khalidi, L., Mendez, V., and Teira, L. (2016). Systems of Interaction between the first sedentary villages in the near east exposed using agent-based modelling of obsidian exchange. *Systems* 4, 18. doi: 10.3390/systems4020018
- Renfrew, C. (1986). “Introduction: peer polity interaction and social change,” in *Peer Polity Interaction and Social Change*, Renfrew, C., and Cherry, J. F. (eds.). Cambridge: Cambridge University Press, 1–18.
- Snir, A., Nadel, D., Groman-Yaroslavski, I., Melamed, Y., Sternberg, M., Bar-Yosef, O., et al. (2015a). The origin of cultivation and proto-weeds, long before Neolithic farming. *PLoS ONE* 10, e0131422. doi: 10.1371/journal.pone.0131422
- Snir, A., Nadel, D., and Weiss, E. (2015b). Plant-food preparation on two consecutive floors at Upper Paleolithic Ohalo II, Israel. *J. Archaeol. Sci.* 53, 61–71. doi: 10.1016/j.jas.2014.09.023
- Sterelny, K. (2011). *The Evolved Apprentice: How Evolution Made Humans Unique*. Cambridge, MA: MIT Press. doi: 10.7551/mitpress/9780262016797.001.0001
- Sterelny, K. (2018). Religion re-explained. *Religion Brain Behav.* 8, 406–425. doi: 10.1080/2153599X.2017.1323779
- Sterelny, K. (2020). Demography and cultural complexity. *Synthese* 198, 8557–8580. doi: 10.1007/s11229-020-02587-2

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fhumd.2023.1250167/full#supplementary-material>

- Sterelny, K., and Watkins, T. (2015). Neolithization in southwest Asia in a context of niche construction theory. *Cambridge Archaeol. J.* 25, 673–691. doi: 10.1017/S0959774314000675
- Stordeur, D. (2015). *Le village de Jerf el Ahmar (Syrie, 9500-8700 av. J.-C.): L'architecture, miroir d'une société néolithique complexe*. Paris: CNRS Éditions. doi: 10.4000/books.editions-cnrs.27975
- Stordeur, D., Brenet, M., Der Aprahamian, G., and Roux, J.-C. (2000). Les bâtiments communautaires de Jerf el Ahmar et Mureybet, horizon PPNA (Syrie). *Paléorient* 26, 29–44. doi: 10.3406/paleo.2000.4696
- Valla, F., and Bocquentin, F. (2009). “Les maisons, les vivants, les morts: le cas d'Eynan (Mallaha), Israël,” in *Proceedings of the 5th International Congress on the Archaeology of the Ancient Near East Madrid 2009*. Madrid: Universidad Autónoma de Madrid, 521–546.
- Valla, F., Khalaily, H., Samuelian, N., Bocquentin, F., Bridault, A., and Rabinovich, R. (2017). “Eynan (Ain Mallaha),” in *Quaternary of the Levant: Environments, Climate Change, and Humans*, Bar-Yosef, O., and Enzel, Y. (eds.). Cambridge: Cambridge University Press, 295–302.
- Vigne, J.-D., Cucchi, T., Rousou, M., Bailon, S., Carrère, I., Devillers, B., et al. (2023). Historical dynamics of the human-environment interactions in Cyprus during the 12th-10th millennia cal. BP: The last 30 years contributions of the Amathous area (Limassol district). *J. Archaeol. Sci. Rep.* 50, 104049. doi: 10.1016/j.jasrep.2023.104049
- Watkins, T. (1990). The origins of house and home? *World Archaeol.* 21, 336–347. doi: 10.1080/00438243.1990.9980112
- Watkins, T. (2004a). “Architecture and “theatres of memory” in the Neolithic of South West Asia,” *Rethinking Materiality: the Engagement of Mind With the Material World*, DeMarrais, E., Gosden, C., Renfrew, C. (eds.). Cambridge: McDonald Institute of Archaeological Research, 97–106.
- Watkins, T. (2004b). Building houses, framing concepts, constructing worlds. *Paléorient* 30, 5–24. doi: 10.3406/paleo.2004.4770
- Watkins, T. (2008). Supra-regional networks in the Neolithic of Southwest Asia. *J. World Prehist.* 21, 139–171. doi: 10.1007/s10963-008-9013-z
- Willcox, G. (2012). “Pre-Domestic Cultivation during the Late Pleistocene and Early Holocene in the Northern Levant,” in *Biodiversity in Agriculture: Domestication, Evolution, and Sustainability*, Gepts, P., et al. (eds.). Cambridge: Cambridge University Press, 92–109.



OPEN ACCESS

EDITED BY

Gary M. Feinman,
Field Museum of Natural History, United States

REVIEWED BY

Lisa DeLance,
University of La Verne, United States
Adrian Chase,
The University of Chicago, United States
Lacey Carpenter,
University at Buffalo, United States

*CORRESPONDENCE

Jessica MacLellan
✉ maclelj@wfu.edu

RECEIVED 12 December 2023

ACCEPTED 15 January 2024

PUBLISHED 25 January 2024

CITATION

MacLellan J (2024) Settling down at Ceibal and Cuello: variation in the transition to sedentism across the Maya lowlands. *Front. Hum. Dyn.* 6:1354725. doi: 10.3389/fhumd.2024.1354725

COPYRIGHT

© 2024 MacLellan. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Settling down at Ceibal and Cuello: variation in the transition to sedentism across the Maya lowlands

Jessica MacLellan*

Department of Anthropology, Wake Forest University, Winston-Salem, NC, United States

During the Middle Preclassic period (c. 1000–350 BCE), the people of the Maya lowlands transitioned from a mobile horticulturalist to sedentary farming lifestyle, exemplified by permanent houses arranged around patios and rebuilt over generations. Early evidence of this change has been found in northern Belize, in the Belize Valley, and at Ceibal, Guatemala. At Cuello and other sites in northern Belize, mortuary rituals tied to ancestor veneration created inequality from the beginning of sedentary life. There, relatively dense populations facilitated the emergence of competitive sociopolitical strategies. However, Maya communities in different regions adopted different aspects of sedentism at different times and employed different power strategies. Unlike Cuello, Ceibal was founded as a ceremonial center by semi-mobile people. Middle Preclassic ritual practices at Ceibal and in the Belize Valley were associated with more collective leadership. At the end of this period, increased population densities contributed to a shift to more exclusionary rituals and political strategies throughout the lowlands.

KEYWORDS

Maya archaeology, household archaeology, ritual, ancestor veneration, sedentism, Preclassic Maya, Mesoamerica, social complexity

Introduction

Compared to other parts of Mesoamerica, the transition from a mobile horticulturalist lifestyle to a sedentary agriculturalist lifestyle occurred relatively late in the Maya area. While the lowland Maya had been cultivating domesticated maize and other plants for centuries, they maintained a mobile, pottery-free, Archaic-style lifestyle until c. 1000 BCE (Lohse, 2010) – possibly as early as 1200 BCE in a few locations (Sullivan et al., 2018; Inomata et al., 2020). Around 1000 BCE, much of Mesoamerica became dependent on maize agriculture, thanks to the intensification of agricultural practices, the spread of more productive maize plants, or both (Rosenswig et al., 2015). The new reliance on agriculture was part of the gradual, heterogenous process through which the Maya settled down. During the Middle Preclassic period (c. 1000–350 BCE), the Maya began to build permanent dwellings around open patios that were occupied and remodeled over generations. Archaeologically, we identify the earliest permanent Maya sites based on the presence of early (pre-Mamom phase) Maya ceramics (Inomata, 2017a; Andrews et al., 2018; Sullivan et al., 2018; Walker, 2023) and their locations below later Maya architecture. Clear evidence of the transition to sedentary life, including ceramics, architecture, and

radiocarbon dates, has been found in Yucatan; northern Belize; the Belize Valley region; Aguada Fénix, in Tabasco; and Ceibal, in Guatemala (Figure 1).

The people who settled the Maya lowlands were in contact with complex Mesoamerican societies, such as the Gulf Coast Olmec, that had long been sedentary and included centralized rulership (Rosenzweig, 2010). Although the early Maya participated in some of the same practices as those societies, including building monumental ceremonial centers and depositing caches of greenstone objects (Clark and Hansen, 2001; Inomata et al., 2013, 2021), the earliest clear evidence of Maya rulers dates to around 100 BCE (Coe, 1965; Saturno, 2009; Inomata et al., 2014). As others have argued, it is important to examine Middle Preclassic social complexity on its own terms, rather than as a prelude to the city-states and divine kings of the Classic period (Canuto, 2016; Pugh, 2021). Complexity is not the same as hierarchy (Crumley, 1987, 1995, 2003), and Middle Preclassic society was made up many different but overlapping communities without being strongly hierarchical (MacLellan and Castillo, 2022).

Rather than simply stating that the Preclassic Maya were less hierarchical than the Olmec, it is useful to consider how power relationships were created among Preclassic Maya people. Blanton et al. (1996) identified two political strategies in ancient Mesoamerica: exclusionary/network and corporate/collective/cooperative. During the Formative Period, the Gulf Coast Olmec exhibited the “network” strategy, through which competitive individuals gained elite status based on long-distance connections and control of prestige goods. This strategy is evidenced by portraits of individual rulers and a widespread, “international” style of art. In contrast, Early Classic Teotihuacan shows evidence of the “corporate” strategy, in which power was more spread out through society, the population willingly collaborated on public works, and individual leaders were not memorialized. Teotihuacan invested in public spaces and apartment complexes, rather than palaces, and the artwork of Teotihuacan is focused on mythology and nature, rather than a ruling elite. These are simplified examples, and exclusionary and collective strategies can exist in the same society, just as hierarchical and non-hierarchical sociopolitical relationships coexist in every society (Crumley, 1995). The balance of exclusionary vs. collective strategies and hierarchical vs. non-hierarchical relationships within a society can also change over time.

Blanton and others continue to investigate cooperation and collective action in Mesoamerican societies, especially in Central Mexico (Blanton and Fargher, 2008; Carballo, 2013; Carballo et al., 2014; Blanton, 2016; DeMarrais and Earle, 2017). These scholars point out that cooperation, in which individual agents sacrifice power or incur risks for the sake of the group, is not a matter of being duped by elites, but is instead an often-rewarding strategy. Using a collective action framework, Feinman and Carballo (2018, p. 11) place “much of the Maya Preclassic” on the “more collective” (more collaborative, less competitive) end of a spectrum for Mesoamerican urban societies, presumably based on low socioeconomic differentiation, lack of identifiable rulers, and investment in communal architecture over palaces and other exclusive spaces. In a review of recent studies of Middle Preclassic complexity, Pugh similarly argues that the early Maya

used cooperative strategies and collective organization to build monumental public works at Nixtun-Ch'ich' and Aguada Fénix (Inomata et al., 2020; Pugh, 2021).

Evidence for economic stratification among the early Maya is sparse. Certain Middle Preclassic households likely had a higher status, based on the elevation of their dwellings on monumental platforms, constructed with the labor of a larger community (Awe, 1992, p. 112–137; Triadan et al., 2017). However, as at the Early Formative site of Paso de la Amada in the Pacific Coast region, this elevation does not necessarily equate with material wealth (Lesure and Blake, 2002). All Middle Preclassic households seem to have had fairly equal access to goods (King, 2016). Diets varied greatly across regions, but trended toward greater maize consumption over time (King, 2016, p. 432–434; Pugh, 2021, p. 552–553). Individual households produced their own food and many crafts, including obsidian tools and shell ornaments (Aoyama et al., 2017; Hohmann et al., 2018; Sharpe and Aoyama, 2023). Long-distance trade of exotic materials like obsidian, greenstone, and marine shell must have been controlled, or at least organized, by specialists (Aoyama, 2017; Sharpe, 2019). For example, Aoyama et al. (2017, p. 411) observe that Middle Preclassic Ceibal probably distributed obsidian to the smaller sites in its periphery. Hohmann et al. (2018, p. 139) argue that a Middle Preclassic marine shell workshop in a residential context at Pacbitun, in the Belize Valley, represents craft specialists engaged in ornament production for exchange. The control of long-distance trade and prestige goods is one way that Preclassic Maya leaders engaged in “less collective” or “exclusionary” power strategies (Blanton et al., 1996; Feinman and Carballo, 2018, p. 11). Nevertheless, obsidian and marine shell artifacts were widespread and accessible across the lowlands.

Perhaps due to the paucity of observable differences in economic status, many archaeologists focus on rituals, including mortuary practices, when discussing early Maya social complexity. Ritual plays a key role in the development of social complexity, because it brings people together while simultaneously facilitating differentiation (Turner, 1969, 1974; Hill and Clark, 2001). Access to certain materials, spaces, and knowledge is limited to specialists, who have particular obligations. Those specialists may or may not gain higher status, but sociopolitical relationships are created through their activities (Bell, 1992, p. 197). These relationships result in communities with shared interests and ideologies (Bell, 1992, p. 125; Yaeger and Canuto, 2000, p. 5–9). For the Preclassic and Classic Maya, gatherings for ritual performances in public plazas were key to the creation of such communities (Inomata, 2006; Estrada-Belli, 2011; Inomata and Tsukamoto, 2014; Inomata et al., 2015a; Brown et al., 2018).

Mortuary rituals have long been used by archaeologists as a proxy for inequality (Saxe, 1970; Binford, 1971; Parker Pearson, 1999, p. 72–94), based on the assumption that the way people are treated after death reflects their lived positions in their communities. This assumption can be misleading, as many factors influence burial practices (Parker Pearson, 1999, p. 83–86; Brück, 2004). Nevertheless, well-documented and securely dated patterns in mortuary practices can convincingly demonstrate social differentiation. According to Blanton et al. (1996), differentiation in burial practices and grave goods is characteristic of less collective, more exclusionary socioeconomic organizations (Feinman and



FIGURE 1
Map of Maya lowlands with Middle Preclassic sites (prepared by Elaine Lu).

Carballo, 2018, p. 11). Burial locations may relate to inequality, especially after the transition to sedentism, as prominent places in the landscape may become resting places for high-status individuals (Joyce, 2004). Special treatment of select ancestors may also legitimate a group's land rights (Goldstein, 1981; Morris, 1991).

Based on evidence from K'axob, in northern Belize, McAnany argues that the earliest sedentary Maya farmers established heritable land rights by interring their dead within their dwellings, by constructing successive house platforms in the same location over generations, and by curating the bones of selected ancestors for use in rituals (McAnany, 1995). Lineages with claims to the best land gained social and political status over time, and the resting places of their most important ancestors became shrines and temples. Mortuary evidence for this practice includes: (1) placement of burials within houses; (2) individuals prepared in relatively complex positions; (3) multiple individuals in one burial – often several secondary (disarticulated, curated, incomplete) interments surrounding a primary individual; (4) presence of secondary burials, particularly bundles that include long bones, maxillae, and mandibles; and (5) differences in grave goods (McAnany et al., 1999). This ancestor veneration model, which describes an exclusionary political strategy, has been very influential in Maya archaeology.

Here, I review the transition to sedentary life in the Maya lowlands through a comparison of two early Maya sites, Cuello and Ceibal, located in different regions. This comparison is possible

thanks to the careful stratigraphic control and detailed publications of the Cuello project. I discuss the construction histories of the earliest residences and the associated domestic rituals, including burials. I argue that a focus on the mortuary records of northern Belize gives an image of the Middle Preclassic period as a time of gradually increasing inequality and competitive political strategies. A wider view shows that more collective strategies were common elsewhere in the Maya lowlands until the end of the Middle Preclassic, when increasing populations may have necessitated exclusionary strategies that led to greater inequality.

Case studies: Cuello and Ceibal

The best known and most complete record of an early Maya village comes from Cuello, which was excavated under the direction of Hammond (1991). For good reasons, data from Cuello and the later village of K'axob (McAnany, 2004), both in northern Belize, have had a major influence on our understanding of the Middle Preclassic (c. 1000–350 BCE) Maya and the origins of sociopolitical complexity in the lowlands. However, great variation existed across the Maya area during this period. The earliest Maya were heterogeneous and spread over different environmental zones. Northern Belize is unusual for its wealth of Archaic period material, indicating a relatively high population density around the transition to sedentary life (Rosenswig, 2021; Valdez et al., 2021).

Communities in other regions emerged under different conditions.

Excavations at Ceibal, directed by Takeshi Inomata and Daniela Triadan, provide new insights into the transition to sedentism. Unlike Cuello, which began with small domestic structures, Ceibal was founded by semi-mobile people as a ceremonial center, with a monumental plaza and formal public rituals (Inomata et al., 2013, 2015b). Preclassic household architecture and rituals at Ceibal differ greatly from those documented in northern Belize. By contrasting the archaeological records of two well documented sites, one sees diversity in the social processes out of which lowland Maya society emerged.

Cuello

Cuello is located in the Orange Walk district of Belize, between the Rio Hondo and the New River (Figure 1). Between 1975 and 2002, Hammond directed 11 seasons of fieldwork, focusing on the Preclassic period at Platform 34 (Hammond, 1991, 2005). Through extensive, meticulous excavations and radiocarbon dating, Hammond and colleagues documented a Middle Preclassic residential area founded at the transition to sedentism.

The earliest permanent occupation, corresponding to the Swasey ceramic phase, was originally dated to before 2000 BCE, but Hammond moved the estimate to 1200 BCE based on a reassessment of the radiocarbon results (Kosakowsky, 1987; Hammond, 2005). Meanwhile, Andrews favored a date after 1000 BCE based on more recent radiocarbon dates and stylistic analyses (Andrews and Hammond, 1990). Further consideration of the contexts of carbon samples, comparisons to ceramic collections from other sites and a Bayesian statistical analysis of the dates lead both John Lohse and Takeshi Inomata to argue that sedentary life and ceramic use at Cuello began around 1000 BCE (Lohse, 2010; Inomata, 2017a). The Swasey phase corresponds to the Real 1 phase at Ceibal and Cunil phase in the Belize Valley (Table 1). The beginning date for the Cunil phase is supported by Lohse's review of recent radiocarbon dates (Lohse, 2023). Cuello's Bladen ceramic phase dates to around 800–600 BCE, covering the transition from the Early Middle Preclassic to the Late Middle Preclassic period. The Bladen phase corresponds to Real 2, Real 3, and Escoba 1 at Ceibal and Early Jenney Creek in the Belize Valley.

Early Middle Preclassic: Swasey phase

The earliest architecture at Cuello consists of post holes in the natural, sterile soil and bedrock surface, associated with Swasey phase ceramics (Gerhardt, 1988; Hammond et al., 1991b). Soon after, the first house platforms were constructed. These are low, apsidal in shape, and plastered. Post holes show that the platforms supported perishable dwellings. During the second part of the Swasey ceramic phase, house platforms were arranged around the first patio, which was covered by a plaster floor. Similar domestic patio groups were constructed at Blackman Eddy, in the Belize Valley region, as early as 1000 BCE (Brown and Garber, 2005).

Three burials (Burials 62, 159 + 167, and 179 + 180) may date to the Swasey phase, but their chronologies are unclear (Robin, 1989; Hammond et al., 1991b, p. 31, 32, 1992; Hammond,

1999). These burials are not associated with Swasey period constructions and do not contain grave goods. Burials 159+167 and 179+180 were found near Bladen-phase burials and structures, while Burial 62 was found in a depression in the bedrock. Radiocarbon dates from bones of Burials 62 and 179 suggest these individuals died before 1000 BCE, but the contamination of Burial 62 with conservation chemicals made its initial dating uncertain (Hammond et al., 1991a, p. 31, 32). A radiocarbon date measured after removing contaminants gives a calibrated date around 1000 BCE (Law et al., 1991), so Burial 62 may belong to the Swasey phase. Based on the stratigraphy, it is likely that Burials 179+180 and 159+167 belong to the Bladen period, and the radiocarbon date from 179 is unreliable (Inomata, 2017a, p. 334, 335). Alternatively, Lohse argues that all three early burials may actually represent a pre-ceramic, Archaic era population (Lohse, 2010).

Early Middle Preclassic: Bladen phase

The practice of building apsidal, plastered house platforms and perishable superstructures around an open patio continued throughout the Bladen phase (Gerhardt, 1988; Hammond et al., 1991b). House platforms grew taller and more elaborate as they were rebuilt over Swasey phase predecessors and renovated multiple times. The earliest known sweat bath in the Maya lowlands was constructed in the domestic group during this period (Hammond and Bauer, 2001; Hammond et al., 2002; Hammond, 2005).

During Bladen times, the residents began to deposit burials in house platforms. At least 17 burials belong to this phase (Robin, 1989; Hammond et al., 1991a,b, 1992, 1995, 2000; Hammond, 1999). Seven individuals are children. The graves contain many highly varied grave goods, including ceramic vessels, jade beads, two Olmec-style jade pendants (one in the burial of a female adult and the other in the burial of a child), stone tools, shell jewelry, marine shells, one ocarina, and cylinder seals. Adults of both sexes and children received burial offerings. The individuals in Burial 2 and Burial 9 show signs of being de-fleshed before burial, and Burial 2 was disarticulated. Burial 9 was interred in an unusual, seated position and is also the only Bladen burial found in the patio rather than a house platform.

Late Middle Preclassic

At the transition to the Late Middle Preclassic period, or Lopez-Mamom ceramic phase (c. 600–350 BCE), the low domestic platforms around the patio were renovated and rebuilt. During the subsequent construction phase, Structures 315 and 314 became the earliest rectangular platforms in the group (Gerhardt, 1988; Hammond et al., 1991b, 2002; Hammond, 2005). These structures were also the first to support stone superstructures. Structure 315, on the north side of the patio, was only 8 meters long and 5 meters

TABLE 1 Preclassic ceramic chronologies of Cuello, Ceibal, and Belize Valley, with approximate date ranges (after [Inomata, 2017a](#)).

Period	Cuello	Ceibal	Belize Valley
Early Middle Preclassic	Swasey (1000–800 BCE)	Real 1 (1000–850 BCE)	Cunil (1000–800 BCE)
	Bladen (800–600 BCE)	Real 2 (850–750), Real 3 (750–700 BCE)	Early Jenney Creek (800–600 BCE)
Late Middle Preclassic	Lopez (600–350 BCE)	Escoba 1 (700–600), Escoba 2 (600–450), Escoba 3 (450–350 BCE)	Late Jenney Creek (600–350 BCE)
Late and Terminal Preclassic	Cocos (350 BCE – 200 CE)	Cantutse 1 (350–300), Cantutse 2 (300–150), Cantutse 3 (150–50 BCE)	Barton Creek (350 BCE – 1 CE)
		Xate 1 (50 BCE – 75 CE), Xate 2 (75–150), Xate 3 (150–250 CE)	Mount Hope (1–125), Floral Park (125–300 CE)

wide, and may have been a ritual rather than residential building ([Hammond, 2005](#)).

At least 30 Late Middle Preclassic burials were excavated at Platform 34 ([Robin, 1989](#); [Hammond et al., 1991a,b, 1992, 2002](#); [Hammond, 1999](#)). Six additional burials (Burials 173–175 and 182–184) may date to either the Bladen or Lopez phase ([Hammond et al., 1995, 2000](#)). All but two of the burials were deposited in house platforms. [Hammond \(1999\)](#) sees social differentiation in the burial offerings from this time period. Ceramic vessels and shell jewelry were common grave goods for adults of both sexes and for children. Jade beads were found only in six burials sexed as male. Cuello Burial 160, of an adult male, contained an unusual wealth of offerings: three ceramic vessels, a perforated snail shell, three shell beads, three jade beads, part of a turtle carapace, four carved bone tubes, and a pendant made from a human skull and decorated with an anthropomorphic face ([Hammond et al., 1992](#); [Hammond, 1999](#)). Three of the individuals (Burials 1, 6, and 152) were missing skulls, but it is not clear whether the skulls were removed before or after deposition.

Late Preclassic

The beginning of the Late Preclassic (c. 350 BCE) was a time of drastic change at Cuello ([Gerhardt, 1988](#); [Hammond et al., 1991b](#), p. 41–43). The patio group at Platform 34 was destroyed, leaving evidence of extensive burning. An offering of jade beads was left in the patio at the termination. Mass Burial 1, containing at least 32 individuals, was created during the process of filling in the patio group with rubble. All the interred were adults and most were male. Most were interpreted as sacrificed or dismembered. Cocos-Chicanel ceramic vessels and carved bone tubes were included in the burial. Two decapitated young adults were also buried in the fill layers, and an infant burial was left in a retaining wall. After the domestic group was filled in, Platform 34 became an open, plastered plaza ([Gerhardt, 1988](#); [Hammond et al., 1991b](#), p. 43, 44). Next, Platform 34 was expanded to the north to construct Structure 312. This is a long structure with a front terrace, facing south, into the patio. Several burials are associated with Structure 312. Fire pits and post holes in the floor outside Structure 312 could indicate domestic activities, but the structure itself may not be residential. Structure 312 and its terrace resemble contemporaneous architecture at the Karinel Group, discussed below.

The foundation of Ceibal

Ceibal is a large Maya site on the Pasión River in southwest Peten, Guatemala ([Figure 1](#)). The site was investigated by Harvard University's Seibal Archaeological Project, directed by Gordon Willey, from 1964 to 1968 ([Willey et al., 1975](#)). The Harvard project documented an Early Middle Preclassic occupation associated with the Real-Xe ceramic phase ([Sabloff, 1975](#)). Cache 7, a cruciform pit in the Central Plaza, contained five Real ceramic vessels, six greenstone axes, and a greenstone bloodletter ([Smith, 1982](#), p. 118, 242–245). This cache was compared to cruciform caches and greenstone artifacts from the Olmec center of La Venta.

In 2005, Inomata and Triadan began the Ceibal-Petexbatún Archaeological Project to explore the Early Middle Preclassic origins of lowland Maya society, building on the work of the Harvard project. Inomata has refined Sabloff's original chronology ([Inomata, 2017a](#); [Inomata et al., 2017b](#)). We have learned that Ceibal's earliest plaza was carved out of the bedrock around 950 BCE, and we suggest that lowland Maya society grew out of multidirectional, interregional interactions during the Middle Preclassic period ([Inomata et al., 2013](#); [Inomata, 2017a](#)). The plaza and associated platforms make up one of the earliest securely dated "E-group" ceremonial complexes in Mesoamerica ([Inomata, 2017b](#)). Early E-groups were aligned with the solar calendar. Beginning at Ceibal's foundation, caches containing greenstone axes were repeatedly deposited along the centerline of the E-group plaza ([Inomata and Triadan, 2015](#); [Inomata et al., 2017a](#)). The E-group layout and caches show connections to sites in Chiapas and the Olmec Gulf Coast ([Clark and Hansen, 2001](#); [Inomata et al., 2013](#)). These activities were organized by specialists, but the people of Middle Preclassic Ceibal emphasized public architecture and cosmological symbolism over the aggrandizement of individual leaders.

Despite extensive excavations, there is little evidence for domestic architecture at Ceibal during the first part of the Early Middle Preclassic. In contrast with Cuello and Blackman Eddy, the earliest clear house platforms date to the Real 3 phase, c. 750–700 BCE ([Table 1](#)). This does not mean there were definitely no permanent dwellings during the Real 1 and 2 phases. For example, it is not clear whether Platform Sulul, a 1.3 m tall structure built near the Central Plaza around 950 BCE, functioned as a residential complex ([Inomata et al., 2013](#); [Triadan et al., 2017](#)). At Caobal, a satellite site of Ceibal, post holes in the bedrock represent a perishable structure dated to the Real 2 (c. 850–750 BCE) or Real 3

phase (Munson and Pinzón, 2017). In the core of Ceibal, Structure Fernando, a small platform carved out of the natural marl soil, is probably a Real 3 house platform (Inomata et al., 2015b; Triadan et al., 2017). Later during the Real 3 phase, Structure Fernando was replaced by Platform K'at, which was 1.6 m–1.9 m tall and may have supported a patio group for a high-status household.

It is conceivable that some people did live in permanent dwellings at Ceibal before the Real 3 phase, and we have not recognized them in the archaeological record. However, a substantial population created and used the early public plaza. We argue that a large part of this population continued a more mobile lifestyle – moving seasonally and living in perishable structures – for some time after the plaza foundation, rather than building and renovating permanent dwellings (Inomata et al., 2015a,b). The same pattern is seen at Yaxuná, in Yucatan, where the E-group dates to the Early Middle Preclassic but no contemporary residences have been identified (Stanton et al., 2022, p. 60–66). Archaeological investigations from around the world have shown that similarly mobile, non-hierarchical groups are capable of monumental constructions for communal rituals (Brück, 1999; Marcus and Flannery, 2004; Saunders et al., 2005; Gibson, 2006; Schmidt, 2010; Burger and Rosenswig, 2012; Dietrich et al., 2013; Ortmann and Kidder, 2013). At Ceibal, the transition to sedentism was gradual and piecemeal, and a formal public space preceded the adoption of formal domestic spaces by most of the population.

Early burials at Ceibal

While a few possible Swasey burials and at least 17 Bladen phase burials were excavated at Cuello, only a handful of burials from Ceibal may date to the Real phase. None were encountered by the Harvard project. Burial 110 was deposited at Platform Sulul during the Real 2 or Escoba 1 (700–600 BCE) phase (Triadan et al., 2017, p. 241). The burial contained a juvenile who died at about 11 years old (according to bioarchaeologist Juan Manuel Palomo) and a spouted ceramic vessel. Burial 136, of a female adult (erroneously reported as male elsewhere), was interred near but not inside the Real 3-era E-group (Inomata et al., 2017a, p. 215). The burial contained four complete Real 3 phase ceramic vessels. Real-phase Burial 132 and Burial 160 (not to be confused with Cuello Burial 160) were excavated in the Karinel Group and will be discussed below. Burial 128 may date to the Real 3 or Escoba phase and was also excavated at the Karinel Group.

In recent years, Melissa Burham has overseen the excavation of a cluster of several possibly preceramic burials at the Amoch Group of Ceibal (Burham, 2022, p. 269, 270). At least two of these burials have been radiocarbon dated to about 1000 BCE or earlier. None are associated with artifacts or architecture. These burials raise the possibility of an Archaic, seasonal occupation at Ceibal that contributed to the foundation of the ceremonial center. If Lohse is correct that the earliest burials at Cuello are preceramic (Lohse, 2010), the Amoch group cemetery could be an important comparative sample. The results of Burham's ongoing investigations should clarify the situation. In this paper, I focus on the Middle Preclassic-era processes in the transition to sedentary life.

The Karinel Group

The Karinel Group (Unit 47) is a residential area 160 m west of the Central Plaza (Smith, 1982, p. 4). The group was investigated by Gair Tourtellot during his survey of the periphery (Tourtellot, 1988, p. 171–174). Based on Tourtellot's test pit, the area was occupied during Real times and the bedrock was relatively close to the ground surface, making it a promising location at which to expose large areas of Early Middle Preclassic domestic architecture and deposits. I oversaw four seasons of excavation from 2012 to 2015 (MacLellan, 2019a,b) (Figure 2). The main objective was to understand the role of household ritual practices in the development of sociopolitical complexity (Burham and MacLellan, 2014; MacLellan, 2019c; MacLellan and Castillo, 2022).

Early Middle Preclassic

The earliest ceramics at the Karinel Group are found in deposits on the bedrock (Subops. 211A and 211D) and dated to the Real 2 phase (c. 850–750 BCE). One alignment of small stones and one possible post hole in the bedrock, near the southern edge of the group, may also date to this period. However, no other post holes have been found in the bedrock and there are no clearly defined structures until Real 3 (c. 750–700 BCE) times. Some evidence of the earliest occupation was doubtless erased by the residents cleaning and living on the bedrock surface throughout the Early Middle Preclassic. While some areas were smoothed, others were left rough. At some point, the northern edge of the basal platform was defined by carving the bedrock (Figure 3).

At the western side of the platform (Subop. 211B, Units 1 and 2, near Str. 46), Burial 132 was placed in a globular chamber in the bedrock (Burham and MacLellan, 2014). There is no other evidence of Real period occupation in the western part of the Karinel Group. Burial 132 contained the skeletons of two adults, seven Real 3 phase ceramic vessels, and an infant of 1–2 months inside one of those vessels. According to Palomo, one of the adults is male and aged 35–50 years. The other is probably female and of the same age range. Three radiocarbon dates from human bone and teeth (PLD-28785: $2482 \pm 20 = 767\text{--}524$ BCE, 2-sigma cal.; PSU-3472: $2520 \pm 20 = 779\text{--}549$ BCE, 2-sigma cal.; PSU-3473: $2482 \pm 20 = 767\text{--}542$ BCE, 2-sigma cal.) overlap with the Real 3 phase [In this paper, Ceibal radiocarbon dates are calibrated in OxCal 4.4 using the IntCal-20 curve (Bronk Ramsey, 1995; Reimer et al., 2020).]

Two other burials at the Karinel Group have been radiocarbon dated to the Early Middle Preclassic. These burials contained no grave goods, and neither was deposited in a house platform. Ceibal Burial 160, the primary burial of an adult sexed as male, was found on the bedrock, in the area of the Terminal Classic patio group (Subop. 211C, Unit 3). After deposition, Burial 160 was cut along the skeleton's medial axis, and the right side of the body and whole skull were removed. This cut may indicate that the orientation of Burial 160 related to a construction project. Two teeth were left behind. Bone from Burial 160 was radiocarbon dated to the Real 2 or Real 3 phase (PSU-5950: $2640 \pm 20 = 826\text{--}789$ BCE, 2-sigma cal.). Burial 128 was also found on the bedrock, in the area of Str. 46, not far from Burial 132. This burial of an adult male was missing

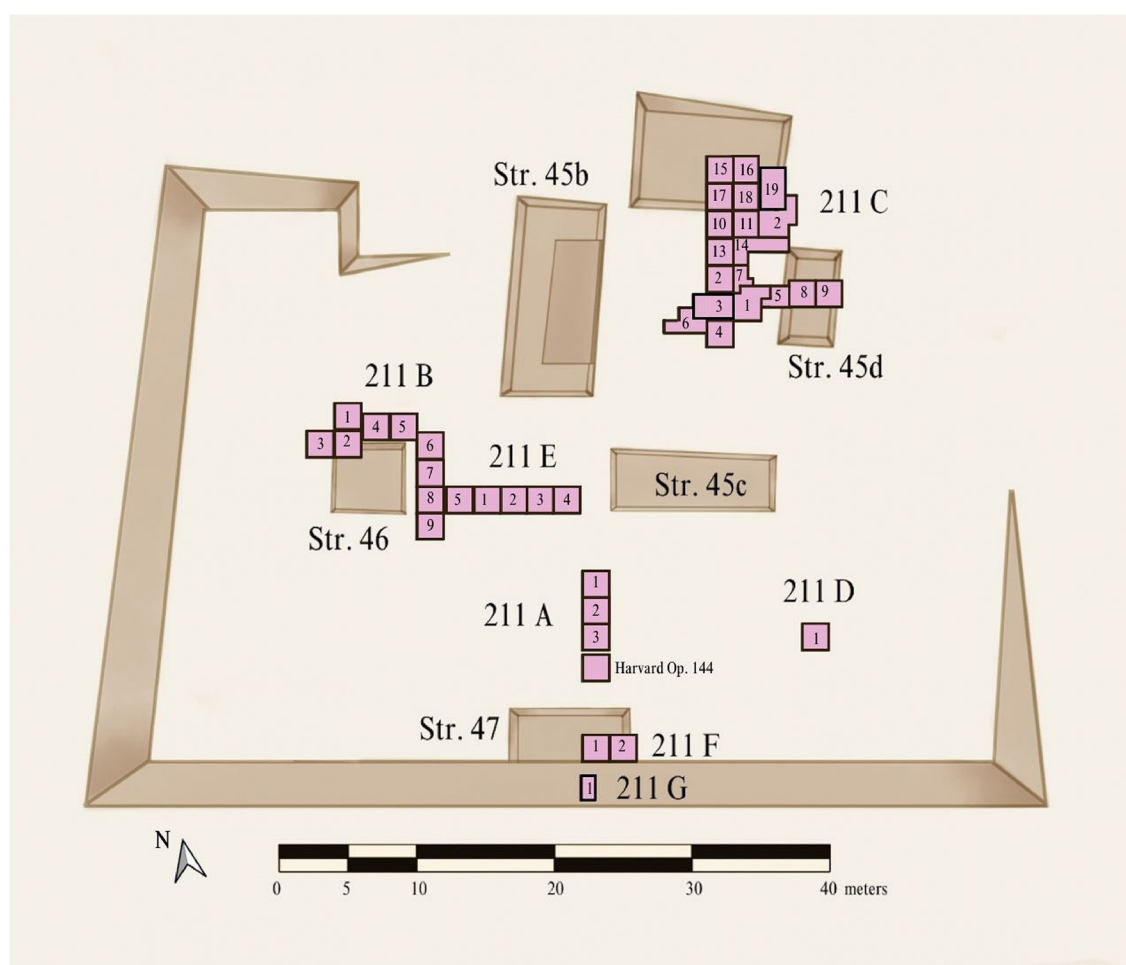


FIGURE 2
Karinell group with excavation units: Suboperations 211A-G and Harvard Op. 144 (after [Smith, 1982](#)). Courtesy of Ceibal-Petexbatún Archaeological Project.

the skull; the left arm, scapula, and hand; both tibiae, but not the fibulae; and the right femur. As with Burial 160, two teeth were found in the area of the missing head. Since the remaining bones were articulated, the burial is primary. It is more likely that selected skeletal elements were removed upon disturbance or reentry than that the bones (e.g., tibiae but not fibulae) were surgically removed while fleshed. Human bone from Burial 128 was radiocarbon dated to the Real 3, Escoba 1, or Escoba 2 phase (PSU-5949: $2510 \pm 20 = 776\text{--}545$ BCE, 2-sigma cal.). Since a large amount of construction activity occurred near the bedrock at the Karinell Group, over a long time period, bones from Burial 128 and Burial 160 may have been removed opportunistically for use in rituals or unknown activities.

During the Real 3 phase, residents of the Karinell Group expanded the basal platform to the north. Early Middle Preclassic platforms in this part of the group are poorly preserved, but middens indicate a residential function. A low circular platform with a diameter of 2.8 m, Structure Pemech-2, was built at this time ([Figure 4](#)) ([MacLellan, 2019a](#), p. 416, 417). Around the transition from the Real phase to the Escoba phase (c. 700 BCE), Ceibal Monument 3 was placed above the circular platform. This monument is a limestone boulder, roughly modified and about 1

m³ in size. Structure Pemech-2 and then Monument 3 may have served as an altar. Monument 3 remained exposed throughout the entire Preclassic period and was incorporated into later structures.

Many fragments of Middle Preclassic (Real and Escoba) ceramic figurines were recovered from the Karinell Group. Their locations in middens and construction fills provide little information about their use. However, these figurines may have been part of domestic rituals ([Cyphers Guillén, 1993](#); [Marcus, 1998](#); [Grove and Gillespie, 2002](#); [Love and Guernsey, 2007](#)).

Late Middle Preclassic

As indicated by domestic middens, the Karinell Group remained residential throughout the Late Middle Preclassic period. The earliest clear patio was created at the beginning of the Escoba-Mamom phase, when an area of natural marl soil was leveled and cleaned (Subop. 211C). A thin marl platform, Structure Saqb'in-4, was constructed at the east side of this leveled area and later rebuilt as Saqb'in-3. Each of the two successive surfaces was only a



FIGURE 3

Sterile bedrock carved during the Early Middle Preclassic (Units 10 and 13, Subop. 211C). Photo: MacLellan. Courtesy of Ceibal-Petexbatún Archaeological Project.

few centimeters thick. The earlier version was white, while Saqb'in-3 was mottled red and white (Figure 5). One exposed post hole indicates that this platform supported a superstructure. The extent of the structure could not be determined, but it was rectangular or apsidal. This structure resembles Real 3 phase house platforms excavated by Triadan in the site core (Triadan et al., 2017, p. 248–251, 257, 258).

During the Escoba 2 phase (c. 600–450 BCE), the Karinel residents began to build taller house platforms with walls made of rough limestone blocks, including Structures Saqb'in-2 and Saqb'in-1 on the eastern side of the patio (Figure 6). They also built circular platform Structure Sutsu in the patio (MacLellan, 2019a). This round structure is about 0.40 m tall, with a diameter of 5 m. Like other Middle Preclassic round platforms across the Maya lowlands, Structure Sutsu did not have a superstructure and was likely used for performances, such as dances (Aimers et al., 2000; Hendon, 2000; MacLellan and Castillo, 2022).

At the western side of the Karinel Group (Subop. 211B), the basal platform was extended by the addition of rectangular Structure Tz'unun, one corner of which was located precisely above Burial 132 (Figure 7). Household crafting activities in this area included obsidian blade manufacture, as evidenced by a knapper's midden (Aoyama et al., 2017; Sharpe and Aoyama, 2023).

Below Structure 47, a small temple at the southern edge of the group (Tourtellot, 1988, p. 171–174), we encountered another circular platform, contemporaneous with Sutsu (MacLellan and Castillo, 2022, p. 7, 8). Structure 47-Sub-3 has a diameter of about 6 m and is about 0.2 m tall. While Structure Sutsu has an outer wall of rough limestone blocks, the wall of 47-Sub-3 is made up blocks of soft, white limestone. Unlike the rest of the Karinel Group, the area around 47-Sub-3 was resurfaced with several successive, thin, plaster floors.

During the Escoba 3 phase (c. 450–350 BCE), rectangular house platforms (Strs. Pemech-1, Ayiin) were constructed around the patio (Figure 4). A large midden in an intrusion in the patio may be evidence of a communal feast (MacLellan and Castillo, 2022, p. 6–8). On the western side of the Karinel Group (Subop. 211B), an extension of the basal platform, called Structure Maax, was built over Structure Tz'unun (Figure 7), and a human scapula was left in one of the retaining walls.

Late Middle Preclassic–Late Preclassic transition

As at Cuello, the transition to the Late Preclassic period, around 350 BCE, was a time of major changes at the Karinel Group. At that point, ritual activity in Ceibal's residential groups became similar to rituals conducted in the public center and probably focused on emergent elites (Burham and MacLellan, 2014; MacLellan, 2019c). Semi-public spaces were constructed in outlying groups (Burham et al., 2020; Burham, 2022). Ritual caching was undertaken in residential areas. Ceramic figurines became rare. Circular Structures Sutsu and 47-Sub-3 were buried.

The Late Middle Preclassic patio group at the Karinel Group was filled in, creating an open space. Residents created the first cache of a complete ceramic vessel (Cache 175) and deposited a human ilium above the buried dwellings (MacLellan, 2019c).

Late Preclassic

During the Cantutse-Chicanel 1 phase (c. 350–300 BCE), circular Structure 47-Sub-3 was replaced by a rectilinear structure.

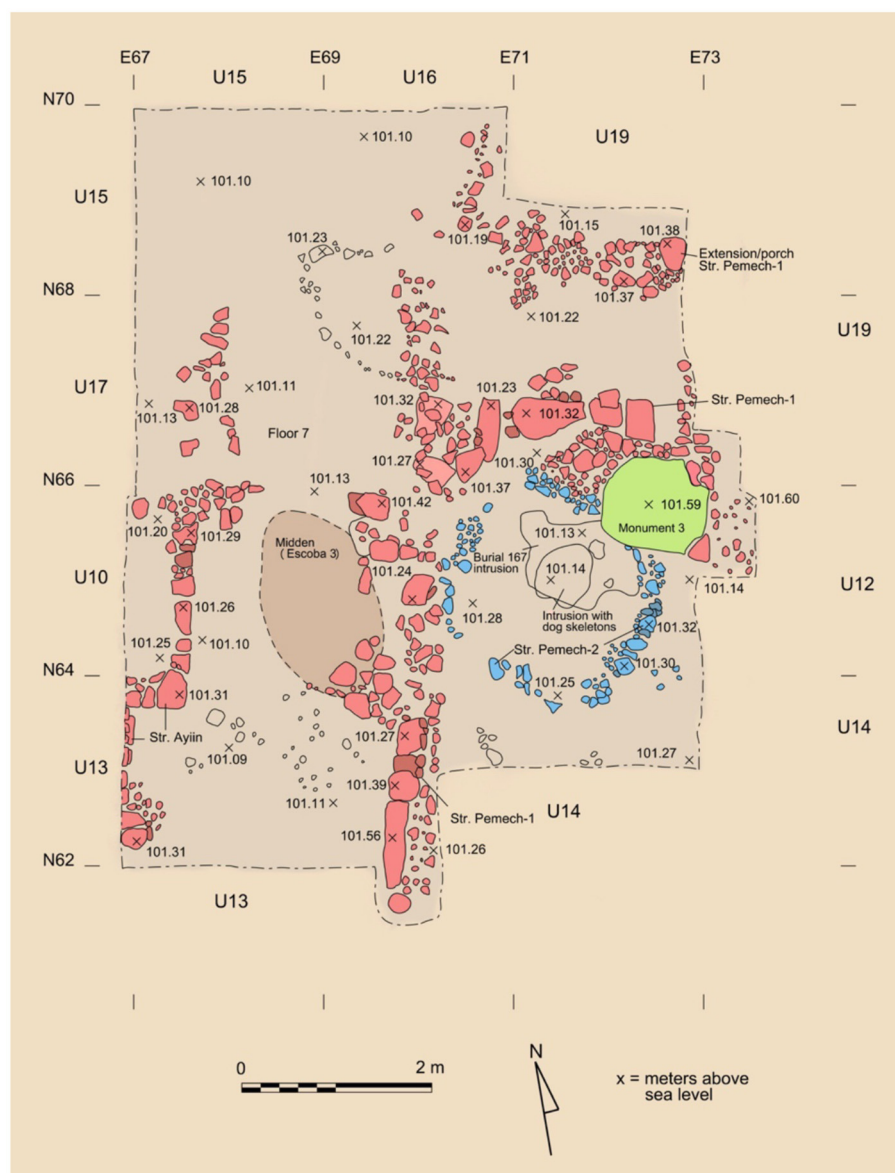


FIGURE 4
Locations of Str. Pemech-2 (blue) and Monument 3 (green), with Late Middle Preclassic Strs. Pemech-1 and Ayiin (pink). Courtesy of Ceibal-Petexbatún Archaeological Project.

As during the Escoba-Mamom phase, several successive, thin, plaster and burned clay floors covered the area of Str. 47. Meanwhile, Structure 45a-Sub-1 was built above the buried Middle Preclassic patio group. This long platform with a front terrace faced south, toward a yellow plaster floor (Figure 8). This building resembles the contemporaneous Structure 312 at Cuello. At least one superstructure stood on the platform, but it is unclear whether this was residential. This part of the group may have become a semi-public space during the Cantutse phase. Although the architecture was dramatically transformed, the top of Monument 3 was still visible.

Unlike many outlying residential groups at Ceibal and Platform 34 at Cuello, the Karinel Group never featured a temple pyramid. This might be due to the group's proximity to the Central Plaza. Structure 47 may have served as a special ritual space for the household, judging by its unusual architecture. During the early part of the Terminal Preclassic (Protoclassic) period (c. 50 BCE – 150 CE), a cache of 18 ceramic vessels (Cache 159) was placed in front of Structure 47 (Subop. 211A) and resembled contemporaneous caches in the Central Plaza (Burham and MacLellan, 2014; MacLellan, 2019c).



FIGURE 5

Patio floor and edge of Str. Saqb'in-3 from above (Unit 5, Subop. 211C). Post hole above north arrow. Photo: MacLellan. Courtesy of Ceibal-Petexbatún Archaeological Project.

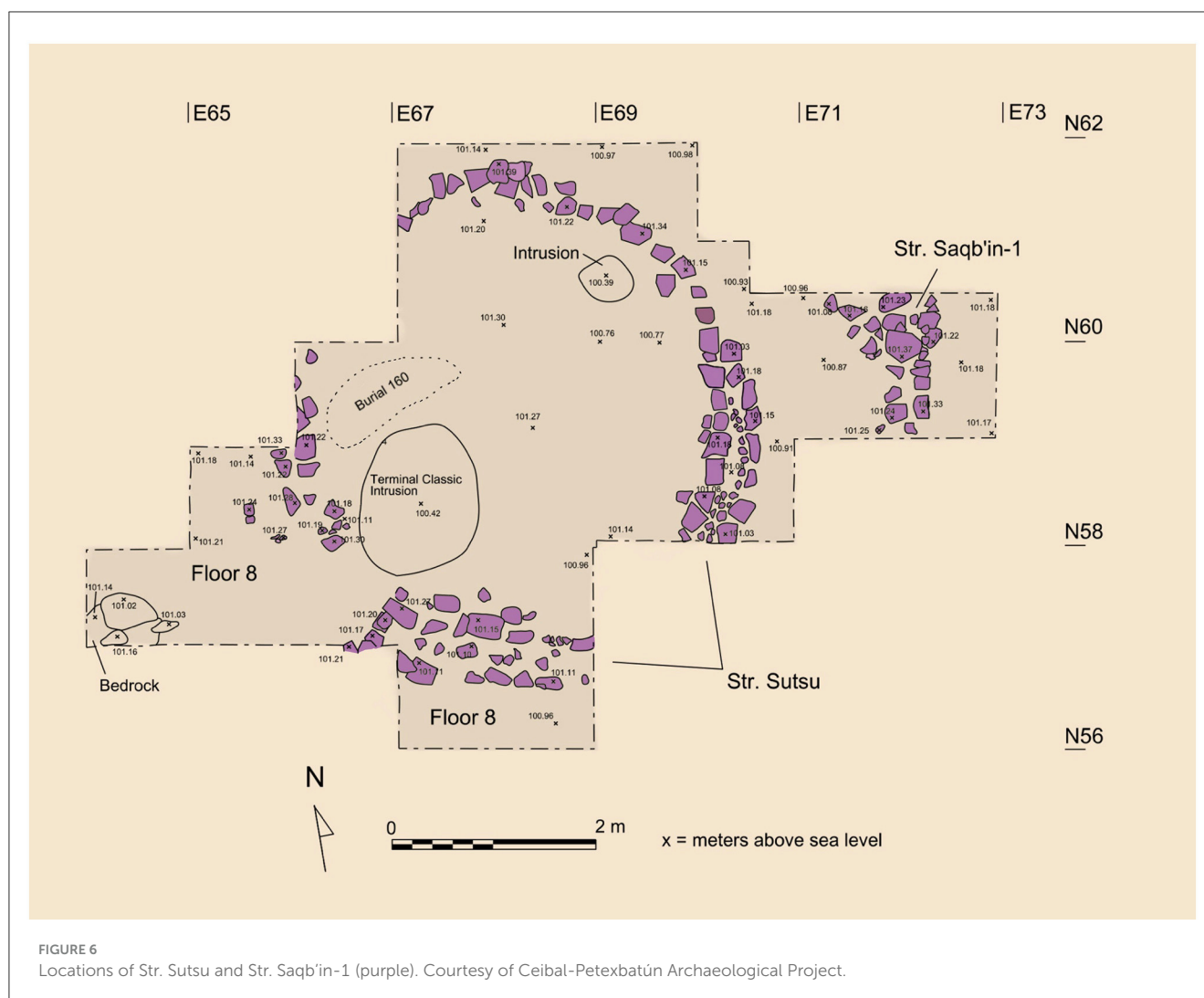
Discussion

During the Preclassic period, the lowland Maya went from mobile horticulturalists to sedentary farmers, living atop permanent house platforms that were rebuilt many times. This transition was not uniform across the lowlands. Communities in different regions adopted different aspects of sedentism at different times. The social processes and political strategies involved in the development of complex Maya society also varied geographically (Table 2). A comparison of the early architecture and mortuary practices of Cuello and Ceibal highlights that variation.

At Ceibal, early public ceremonial architecture and caches point to important interactions with groups in Chiapas and the Gulf Coast area. Although we do not dismiss the possibility that earlier durable domestic architecture existed, the lack of unequivocal evidence for such constructions before 750 BCE suggests that a significant portion of the population around Ceibal maintained some level of residential mobility for a few generations after the plaza's foundation (Inomata et al., 2015a,b). Households did not constantly occupy and renovate domestic structures. Instead, they may have relocated seasonally or every

few years. In this way, Ceibal resembles Yaxuná and differs from sites in northern Belize and the Belize Valley, where permanent house platforms and formal patio groups were built around 1000 BCE. By the Late Middle Preclassic, however, the people of Ceibal were also occupying and rebuilding patio groups over generations.

Comparing the mortuary practices of northern Belize to those of the rest of the lowlands reveals major differences in social processes. The region is unusual in its high quantity of Middle Preclassic burials. Few Early Middle Preclassic burials are known from elsewhere in the lowlands, and even Late Middle Preclassic burials are relatively uncommon (Ringle, 1985, p. 288–313; Awe, 1992, p. 334, 335; Wrobel et al., 2021). The practice of burying the dead in house platforms began very early at Cuello, around 800 BCE. Other probable pre-Mamom examples can be seen at K'axob (Storey, 2004), Altun Ha (Pendergast, 1982, p. 170–204), and Santa Rita Corozal (Chase et al., 2018), also in northern Belize. Burials in house platforms became common much later elsewhere in the lowlands. Several burials at Dzibilchaltun, in northern Yucatan, suggest the custom began there during the Late Middle Preclassic (Andrews and Andrews, 1980, p. 21–41). The few Late Middle



Preclassic burials found at Cahal Pech do not seem to be inside dwellings (Awe, 1992; Lee and Awe, 1995). At Ceibal and its satellite site Caobal, Burial 11 (Tourtellot, 1990) and Burial AN4 (Munson, 2012) were placed in house platforms at the end of the Late Middle Preclassic, during the Escoba 3 phase. The few Middle Preclassic burials at the Karinel Group were not located within houses.

The Bladen and Lopez phase burials at Cuello are more richly furnished than contemporaneous burials outside northern Belize. Based on the large sample of grave goods, Hammond (1999) sees an increase in social differentiation during the Lopez phase. Cuello Burial 160 included ornaments made from jade imported over a long distance and a human skull pendant that might represent a trophy head and individual success in battle – hinting at an “exclusionary” political strategy (sensu Blanton et al., 1996).

At K'axob, near Cuello, McAnany found a similarly complex Preclassic burial record, beginning c. 800–600 BCE. Although burials beneath houses date to the foundation of K'axob (Storey, 2004, p. 110–112), elaborate ancestor veneration practices (including bundled secondary burials) did not appear until the Late Preclassic period. As others have noted, descriptions and

drawings of Late and Terminal Preclassic K'axob burials used to argue for ancestor veneration are very similar to burials interpreted as human sacrifices at Cuello, including Mass Burial 1 described above (Hammond, 1991; McAnany, 2004; Hageman, 2016). Hammond (1999, p. 55) points out that some children are buried in house platforms with grave goods, and that children do not fit the literal definition of ancestors. Nevertheless, Hammond's (1999) analysis of the emergence of inequality at Cuello through mortuary data mirrors McAnany's study of ancestor veneration at K'axob.

The ancestor veneration model developed by McAnany has been very influential throughout the lowlands but does not fit data from every region. For example, Brown and Robin interpret Middle Preclassic burials in public plazas at Xunantunich and Chan, both in the Belize Valley, as examples of ancestor veneration (Robin et al., 2012, p. 126–128; Brown, 2017; Robin, 2017; Brown et al., 2018, p. 108–110). Like Ceibal Burials 128 and 160, these burials were disturbed in antiquity, when elements were removed, probably for ritual use. Like Ceibal Burials 128 and 160 and unlike the K'axob cases, there were no associated grave goods – making it hard to argue for high status. Importantly, McAnany

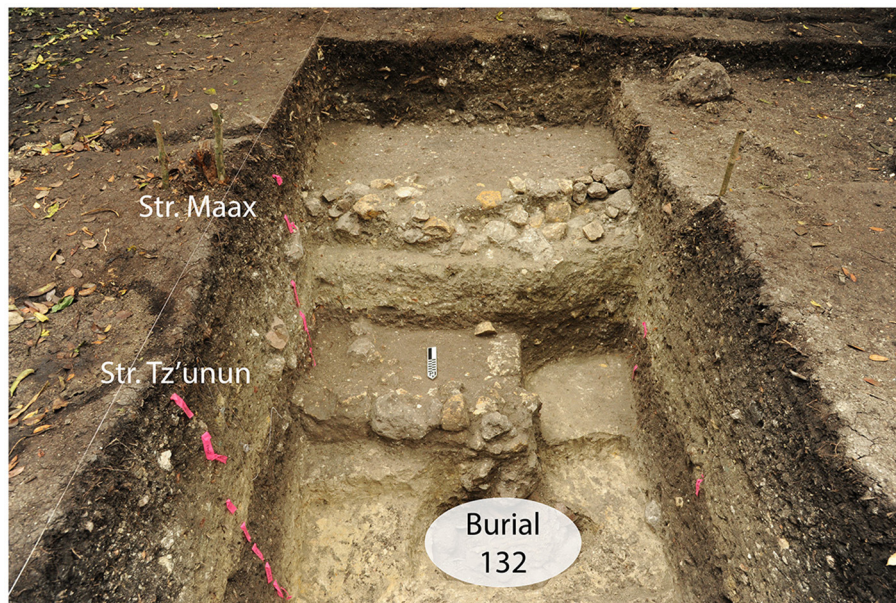


FIGURE 7

Str. Tz'unun above Burial 132 (Subop. 211B). Photo: MacLellan. Courtesy of Ceibal-Petexbatún Archaeological Project.



FIGURE 8

Late Preclassic Str. 45a-Sub-1 (Subop. 211C). Photo: MacLellan. Courtesy of Ceibal-Petexbatún Archaeological Project.

argues that Preclassic ancestor veneration was undertaken by a lineage within a residence, and not by an entire community in a public space. Even if the burials at Xunantunich and Chan are of high-status individuals, there is no evidence that the status was inherited or associated with land rights, which are key elements of McAnany's model. If the burials at Xunantunich and Chan

were of venerated leaders, they present a more collective view of ancestors – and a more “corporate” political strategy (sensu [Blanton et al., 1996](#)). In addition, interpretations of Preclassic round platforms in the Belize Valley as ancestor shrines are based on unlikely interpretations of stratigraphy ([MacLellan and Castillo, 2022](#), p. 3). DeLance and Awe argue that Middle Preclassic figurines

TABLE 2 Comparison of Cuello, Ceibal, and Belize Valley during the Middle Preclassic period.

	Cuello	Ceibal	Belize Valley
Residential mobility	Sedentary, relatively dense population.	Semi-mobile until c. 750 BCE, then sedentary.	Sedentary.
Public ritual	No known Middle Preclassic communal architecture/ public space.	Communal earthworks, E-group plaza, greenstone caches from 1000 BCE.	Communal architecture, public E-group plazas after 800 BCE.
Domestic ritual	Inequality in burials, exclusionary ancestor veneration. Possible circular platform. Ceramic figurines.	No inequality in burials, no exclusionary ancestor veneration. Circular platforms. Ceramic figurines.	No inequality in burials, no exclusionary ancestor veneration. Circular platforms. Ceramic figurines.

at Cahal Pech represent ancestor veneration, but their evidence comes from the reuse of these figurines in Classic period contexts (DeLance and Awe, 2022). Inverting McAnany's model, they see ancestor veneration as a less hierarchical, cooperative practice that was replaced at the beginning of the Late Preclassic by a more hierarchical, competitive system.

Domestic architecture at Ceibal does not show increasing inequality related to burials in house floors, as seen at Cuello and K'axob. While Karinel Group house platforms were rebuilt multiple times, neither the houses nor Structure 47 was built over an ancestral burial. Late Middle Preclassic Structure Tz'unun was intentionally built above Early Middle Preclassic Burial 132, suggesting early burials might have tied Ceibal residents to places during the transition to fully sedentary life. However, there was no subsequent social differentiation in Late Middle Preclassic burials. The rituals carried out on circular structures at Ceibal, Cahal Pech, and elsewhere probably created unranked, rather than hierarchical, relationships among households (MacLellan and Castillo, 2022). At Ceibal, the proximity of Platform K'at (and potentially the earlier Platform Sulul) to the Central Plaza hints that Middle Preclassic status was tied to public rituals and cosmological symbols, rather than land rights. The same pattern is seen at Plaza B of Cahal Pech (Awe, 1992, p. 112–137).

Although scholars working across the Maya area reference ancestor veneration, the process described by McAnany differs from the mortuary evidence seen at Ceibal or in the Belize Valley. Archaeologists should be explicit about what specific social processes we refer to when we invoke a concept like “ancestor veneration.” The continuum of cooperative to competitive strategies, developed by Blanton et al. (1996), is one lens through which to differentiate such processes. For example, one might describe the northern Belize mortuary practices as exclusionary ancestor veneration and the Chan and Xunantunich plaza examples as collective ancestor veneration. Ceibal Burial 136, in a public space, would also fall on the collective side. In contrast, the construction of Str. Tz'unun over Burial 132 at the Karinel Group might represent a more exclusionary effort, connecting a particular household across generations. However, most of the evidence for exclusionary ancestor veneration cited in northern Belize was absent at Ceibal throughout the Middle Preclassic.

Why did exclusionary rituals related to land rights emerge so early in northern Belize? There is probably no simple answer, but the relatively dense population, beginning in the Archaic period (Rosenswig, 2021; Valdez et al., 2021), must have played a role. Feinman and Neitzel use ethnographic and archaeological

evidence from around the world to argue that societies undergo reorganizations at key demographic thresholds, due to increased social stresses caused by human cognitive limitations (Feinman and Neitzel, 2023). If these societies do not fission into smaller groups, then “institutions” – groups with shared objectives and regularized practices (Holland-Lulewicz et al., 2020) – are necessary to socially bind them together. This model is about interpersonal relationships, rather than subsistence or carrying capacity. However, institutions require labor and other resources, and Feinman and Neitzel argue that if those resources, such as land rights, are heritable and monopolizable, political strategies will be exclusionary and will increase inequality. The founders of Ceibal lived in small, dispersed, semi-mobile groups and exploited many wild resources in addition to planting maize. Meanwhile, the founders of Cuello may have been overwhelmed by social tensions and in greater competition for resources. The ancestor veneration identified by McAnany may represent the institutionalized leadership that the larger communities of northern Belize required for social aggregation. Although ancestor veneration held communities together, it also created hierarchies, with some lineages monopolizing the best farmland and rising in social status (McAnany, 1995).

In terms of chronology, mortuary data from Cuello and K'axob suggest a gradual increase in inequality over the course of the Preclassic. At Ceibal and in other parts of the lowlands, that social change seems more abrupt. Around 350 BCE (the transition to the Chicanel ceramic phase and Late Preclassic period), Ceibal and Cuello were part of a lowlands-wide shift in ideology that included changes in spatial organization and ritual practices at residential groups. Generations-old patio groups at Cuello, Ceibal, Cahal Pech, Dzibilchaltun, and elsewhere were buried to create more open spaces. Temple pyramids were created in peripheral, residential complexes (Ringle, 1999; Munson and Pinzón, 2017; Burham et al., 2020; Burham, 2022). At Ceibal, domestic and public rituals became much more similar (Burham and MacLellan, 2014; MacLellan, 2019c). The earliest clear ritual caches (intrusive deposits of items like whole ceramic vessels) in residential areas are dated to the Middle Preclassic-Late Preclassic transition (MacLellan, 2019c). Ceramic figurines, likely used in Middle Preclassic household rituals, fell out of favor (Guernsey, 2020; DeLance and Awe, 2022). The more homogenous ritual practices of the Late Preclassic seem to be focused on emergent elites, as certain kin groups were – socially and economically – able to build their own pyramids and create their own ritual caches away from communal public plazas. There were doubtless multiple historically contingent causes of this change, but a major

increase in population across the lowlands is one important factor. Maya communities may have crossed a demographic threshold that favored the development of exclusionary political strategies, and resources like farmland and trade routes may have become easier to monopolize (Feinman and Neitzel, 2023, p. 9). By the end of the Late Preclassic (c. 100 BCE), the earliest royal families had emerged.

Conclusion

Variation in the archaeological records of Cuello and Ceibal shows that the Middle Preclassic Maya cannot be simply labeled as “collective” or “not collective”. The relatively dense population of northern Belize facilitated the early development of heritable inequality and competitive sociopolitical strategies, including ancestor veneration. Meanwhile, at Ceibal and in the Belize Valley (and probably also at Aguada Fénix, throughout Petén, and in Yucatán), Middle Preclassic ritual practices and leadership were more collective, despite the rebuilding of patio groups over generations. By focusing on specific political strategies and employing Blanton and colleagues’ continuum of collective to exclusionary, one gains a more nuanced understanding of relationships among residential mobility, ritual, leadership, and inequality. This analysis has implications beyond the Maya area, as archaeologists increasingly recognize that the transition to sedentary life is a complex set of processes that occurred in different combinations at different rates around the globe and throughout history.

Author contributions

JM: Conceptualization, Funding acquisition, Investigation, Visualization, Writing—original draft, Writing—review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. Research at the Karinel Group was funded by the National Science Foundation (BCS-1518794) and the Alphawood Foundation of Chicago (grant to Inomata and Triadan). Additional financial support was provided by Dumbarton Oaks and the University of Arizona

References

- Aimers, J. J., Powis, T. G., and Awe, J. J. (2000). Preclassic round structures of the upper Belize river valley. *Latin Am. Antiq.* 11, 71–86. doi: 10.2307/1571671
- Andrews, E. W., and Andrews, V. E. W. (1980). *Excavations at Dzibilchaltun, Yucatan, Mexico, Middle American Research Institute Publications*. New Orleans: Tulane University.
- Andrews, E. W., Bey, V. G. J., and Gunn, C. M. (2018). “The Earliest Ceramics of the Northern Maya Lowlands,” in *Pathways to Complexity: A View from the Maya Lowlands*, eds M. K. Brown, G. J. Bey (Gainesville, FL: University Press of Florida), 49–86.
- Andrews, E. W., and Hammond, V. N. (1990). Redefinition of the Swasey phase at Cuello, Belize. *Am. Antiq.* 55, 570–584. doi: 10.2307/281287
- Aoyama, K. (2017). Ancient Maya economy: lithic production and exchange around Ceibal, Guatemala. *Ancient Mesoamerica* 28, 279–303. doi: 10.1017/S0956536116000183
- Aoyama, K., Inomata, T., Triadan, D., Pinzón, F., Palomo, J. M., MacLellan, J., et al. (2017). Early Maya ritual practices and craft production: late middle preclassic ritual deposits containing obsidian artifacts at Ceibal, Guatemala. *J. Field Archaeol.* 42, 408–422. doi: 10.1080/00934690.2017.1355769
- (School of Anthropology, Graduate and Professional Student Council, Social and Behavioral Sciences Research Institute). A URECA-x grant from Wake Forest University was used to hire a student to prepare some of the figures in this article. Publication fees were covered by Wake Forest University’s Open Access Publishing Fund.

Acknowledgments

This article relies heavily on publications of the Cuello Archaeological Project (1975–2002), directed by Norman Hammond. It began as part of a symposium in honor of Hammond at the 79th annual meeting of the Society for American Archaeology (2014): “Preclassic Maya Civilization is No Longer a Contradiction in Terms,” organized by Francisco Estrada-Belli and Astrid Runggaldier. Harvard University’s Seibal Archaeological Project (1964–1968) provided the foundation for the Ceibal-Petexbatún Archaeological Project. I am grateful to Takeshi Inomata, Daniela Triadan, Melissa Burham, Flory Pinzón, and all my Ceibal colleagues. Permits were granted by the *Instituto de Antropología e Historia*, Ministry of Culture and Sports, Guatemala. Alejandra Cordero and Evelyn Mejía helped supervise Karinel Group excavations. Juan Manuel Palomo analyzed human remains from Ceibal. Inomata provided comments on an early version of this manuscript. Undergraduate student Elaine Lu prepared some of the figures. I am grateful to three peer reviewers for their time and constructive feedback. Finally, thank you to Gary Feinman and Victor Thompson for the invitation to contribute to this collection.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Awe, J. J. (1992). *Dawn in the Land Between the Rivers: Formative Occupation at Cahal Pech, Belize, and its Implications for Preclassic Development in the Maya Lowlands (Ph.D.)*. London: University of London.
- Bell, C. (1992). *Ritual Theory, Ritual Practice*. New York, NY: Oxford University Press.
- Binford, L. R. (1971). "Mortuary practices: their study and potential," in *Approaches to the Social Dimensions of Mortuary Practices, Memoir*, ed J. A. (Washington, DC: Brown Society for American Archaeology), 6–29.
- Blanton, R. E. (2016). *How Humans Cooperate: Confronting the Challenges of Collective Action*. Boulder, CL: University Press of Colorado.
- Blanton, R. E., and Fargher, L. F. (2008). *Collective Action in the Formation of Pre-Modern States*. New York, NY: Springer.
- Blanton, R. E., Feinman, G. M., Kowalewski, S. A., and Peregrine, P. N. (1996). A dual-processual theory for the evolution of mesoamerican civilization. *Curr. Anthropol.* 37, 1–14. doi: 10.1086/204471
- Bronk Ramsey, C. (1995). Radiocarbon calibration and analysis of stratigraphy: the oxcal program. *Radiocarbon* 37, 425–430. doi: 10.1017/S0033822200030903
- Brown, M. K. (2017). "E groups and ancestors: the sunrise of complexity at xunantunich, belize," in *Maya E Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, eds D. A. Freidel, A. F. Chase, A. S. Dowd (Gainesville, FL: University Press of Florida), 386–411.
- Brown, M. K., Awe, J. J., and Garber, J. F. (2018). "The Role of Ideology, Religion, and Ritual in the Foundation of Social Complexity in the Belize River Valley," in *Pathways to Complexity: A View from the Maya Lowlands*, eds M. K. Brown, G. J. Bey (Gainesville, FL: University Press of Florida), 87–116.
- Brown, M. K., and Garber, J. F. (2005). "The development of middle formative architecture in the Maya lowlands: the blackman eddy, belize, example," in *New Perspectives on Formative Mesoamerican Cultures*, ed T. G. Powis (Oxford: Archaeopress), 39–49.
- Brück, J. (1999). "What's in a settlement? Domestic practice and residential mobility in early bronze age southern England," in *Making Places in the Prehistoric World*, eds J. Brück, M. Goodman (London: Routledge), 52–75.
- Brück, J. (2004). Material Metaphors: the relational construction of identity in early bronze age burials in Ireland and Britain. *J. Soc. Archaeol.* 4, 307–333. doi: 10.1177/1469605304046417
- Burger, R. L., and Rosenswig, R. M. (2012). *Early New World Monumentality*. Gainesville, FL: University Press of Florida.
- Burham, M. (2022). Sacred sites for suburbanites: organic urban growth and neighborhood formation at preclassic Ceibal, Guatemala. *J. Field Archaeol.* 47, 262–283. doi: 10.1080/00934690.2022.2052583
- Burham, M., Inomata, T., Triadan, D., and MacLellan, J. (2020). "Ritual practice, urbanization, and sociopolitical organization at preclassic Ceibal," in *Approaches to Monumental Landscapes of the Ancient Maya*, eds Houk, B.A., Arroyo, B., Powis, T.G. (Gainesville, FL: University Press of Florida), 61–84.
- Burham, M., and MacLellan, J. (2014). Thinking outside the plaza: ritual practices in preclassic Maya residential groups at Ceibal, Guatemala. *Antiq. Proj. Gallery* 88, 1–4. Available online at: <https://www.antiquity.ac.uk/projgall/burham340>
- Canuto, M. A. (2016). "Middle Preclassic Maya Society: Tilting at Windmills or Giants of Civilization?" in *The Origins of Maya States*, eds L. P. Traxler, and R. J. Sharer (Philadelphia, PA: University of Pennsylvania Press), 461–506.
- Carballo, D., Roscoe, P., and Feinman, G. M. (2014). Cooperation and collective action in the cultural evolution of complex societies. *J. Archaeol. Method Theor.* 21, 98–133. doi: 10.1007/s10816-012-9147-2
- Carballo, D. M. (2013). *Cooperation and Collective Action: Archaeological Perspectives*. Boulder, CL: University Press of Colorado.
- Chase, A. S. Z., Chase, D. Z., and Chase, A. F. (2018). *Situating Preclassic Interments and Fire-Pits at Santa Rita Corozal (No. 15), Research Reports in Belizean Archaeology*. Belize: Institute of Archaeology.
- Clark, J. E., and Hansen, R. D. (2001). "The Architecture of Early Kingship: Comparative Perspectives on the Origins of the Maya Royal Court," in *Royal Courts of the Ancient Maya: Volume 2, Data and Case Studies, Vol. 2* (Boulder, CL: Westview Press), 1–45.
- Coe, W. R. (1965). Tikal, Guatemala, and emergent civilization. *Science* 147, 1401–1419. doi: 10.1126/science.147.3664.1401
- Crumley, C. L. (1987). "A dialectical critique of hierarchy," in *Power Relations and State Formation*, eds T. C. Patterson, C. W. Gailey (Washington, DC: American Anthropological Association), 155–169.
- Crumley, C. L. (1995). Heterarchy and the analysis of complex societies. *Archaeol. Papers Am. Anthropol. Assoc.* 6, 1–5. doi: 10.1525/ap3a.1995.6.1.1
- Crumley, C. L. (2003). "Alternative forms of social order," in *Heterarchy, Political Economy, and the Ancient Maya: The Three Rivers Region of the East-Central Yucatán Peninsula*, eds V. L. Scarborough, F. Valdez, N. Dunning (Tucson, AZ: University of Arizona Press), 136–145.
- Cyphers Guillén, A. (1993). Women, rituals, and social dynamics at ancient chalcatzingo. *Latin Am. Antiq.* 4, 209–224. doi: 10.2307/971789
- DeLance, L., and Awe, J. J. (2022). "The complexity of figurines: ancestor veneration at cahal pech, Cayo, Belize," in *Framing Complexity in Formative Mesoamerica*, eds L. DeLance, G. M. Feinman (Boulder, CL: University Press of Colorado), 226–250.
- DeMarrais, E., and Earle, T. (2017). Collective action theory and the dynamics of complex societies. *Ann. Rev. Anthropol.* 46, 183–201. doi: 10.1146/annurev-anthro-102116-041409
- Dietrich, O., Köksal-Schmidt, Ç., Notroff, J., and Schmidt, K. (2013). Establishing a radiocarbon sequence for göbekli tepe: state of research and new data. *Neo-Lithics Newsletter Southwest Asian Neolithic Res.* 15, 36–41. Available online at: https://www.exoriente.org/repository/NEO-LITHICS/NEO-LITHICS_2013_1.pdf
- Estrada-Belli, F. (2011). *The First Maya Civilization: Ritual and Power Before the Classic Period*. New York, NY: Routledge.
- Feinman, G. M., and Carballo, D. M. (2018). Collaborative and competitive strategies in the variability and resiliency of large-scale societies in mesoamerica. *Economic Anthropol.* 5, 7–19. doi: 10.1002/sea.12098
- Feinman, G. M., and Neitzel, J. E. (2023). The social dynamics of settling down. *J. Anthropol. Archaeol.* 69, 101468. doi: 10.1016/j.jaa.2022.101468
- Gerhardt, J. C. (1988). *Preclassic Maya Architecture at Cuello, Belize, BAR International Series*. Oxford: British Archaeological Reports.
- Gibson, J. L. (2006). Navels of the earth: Sedentism in early mound-building cultures in the lower Mississippi valley. *World Archaeol.* 38, 311–329. doi: 10.1080/00438240600694081
- Goldstein, L. (1981). "One-dimensional archaeology and multi-dimensional people: spatial organization and mortuary analysis," in *The Archaeology of Death*, eds R. Chapman, L. Kinnes, K. Randsborg (Cambridge: Cambridge University Press), 53–69.
- Grove, D. C., and Gillespie, S. D. (2002). "Formative domestic ritual at chalcatzingo, morelos," in *Domestic Ritual in Ancient Mesoamerica*, Cotsen Institute of Archaeology Monograph, eds P. Plunket (Los Angeles, CA: Cotsen Institute of Archaeology, University of California), 11–19.
- Guernsey, J. (2020). *Human Figuration and Fragmentation in Preclassic Mesoamerica: From Figurines to Sculpture*. Cambridge: Cambridge University Press.
- Hageman, J. B. (2016). "Where the Ancestors Live: Shrines and Their Meaning among the Classic Maya," in *The Archaeology of Ancestors: Death, Memory, and Veneration*, eds E. Hill, J. B. Hageman (Gainesville, FL: University Press of Florida), 213–248. doi: 10.2307/j.ctvx076wp.13
- Hammond, N. (1991). *Cuello: An Early Maya Community in Belize*. Cambridge: Cambridge University Press.
- Hammond, N. (1999). "The genesis of hierarchy: mortuary and offertory ritual in the pre-classic at cuello, Belize," in *Social Patterns in Pre-Classic Mesoamerica*, eds D. C. Grove, R. A. Joyce (Washington, DC: Dumbarton Oaks), 49–66.
- Hammond, N. (2005). The dawn and the dusk: beginning and ending a long-term research program at the preclassic Maya site of Cuello, Belize. *Anthropol. Notebooks* 11, 45–60.
- Hammond, N., Bauer, J., and Hay, S. (2000). Preclassic Maya architectural ritual at cuello, Belize. *Antiquity* 74, 265–266. doi: 10.1017/S0003598X00059172
- Hammond, N., and Bauer, J. R. (2001). A preclassic Maya sweatbath at Cuello, Belize. *Antiquity* 75, 684–684. doi: 10.1017/S0003598X00089158
- Hammond, N., Bauer, J. R., and Morris, J. (2002). Squaring off: late middle preclassic architectural innovation at cuello, Belize. *Antiquity* 76, 327–328. doi: 10.1017/S0003598X00090359
- Hammond, N., Clarke, A., and Estrada-Belli, F. (1992). Middle preclassic Maya buildings and burials at cuello, Belize. *Antiquity* 66, 955–964. doi: 10.1017/S0003598X00044884
- Hammond, N., Clarke, A., and Estrada-Belli, F. (1995). The long goodbye: middle preclassic Maya archaeology at cuello, Belize. *Latin Am. Antiq.* 6, 120–128. doi: 10.2307/972147
- Hammond, N., Clarke, A., and Robin, C. (1991a). Middle preclassic buildings and burials at cuello, belize: 1990 investigations. *Latin Am. Antiq.* 2, 352–363. doi: 10.2307/971783
- Hammond, N., Gerhardt, J. C., and Donaghey, S. (1991b). "Stratigraphy and chronology in the reconstruction of preclassic developments at cuello," in *Cuello: An Early Maya Community in Belize*, ed N. Hammond (Cambridge: Cambridge University Press), 23–69.
- Hendon, J. A. (2000). Round structures, household identity, and public performance in preclassic Maya society. *Latin Am. Antiq.* 11, 299–301. doi: 10.2307/972180
- Hill, W. D., and Clark, J. E. (2001). Sports, gambling, and government: america's First social compact? *Am. Anthropol.* 103, 331–345. doi: 10.1525/aa.2001.103.2.331
- Hohmann, B., Powis, T. G., and Healy, P. F. (2018). "Middle preclassic shell ornament production: implications for the development of complexity at pacbitun, belize," in *Pathways to Complexity: A View from the Maya Lowlands*, eds M. K. Brown, and G. H. Bey (Gainesville, FL: University Press of Florida), 117–146.

- Holland-Lulewicz, J., Conger, M. A., Birch, J., Kowalewski, S. A., and Jones, T. W. (2020). An institutional approach for archaeology. *J. Anthropol. Archaeol.* 58, 101163. doi: 10.1016/j.jaa.2020.101163
- Inomata, T. (2006). Plazas, performers, and spectators: political theaters of the classic Maya. *Curr. Anthropol.* 47, 805–842. doi: 10.1086/506279
- Inomata, T. (2017a). The emergence of standardized spatial plans in southern mesoamerica: chronology and interregional interactions viewed from Ceibal, Guatemala. *Ancient Mesoamerica* 28, 329–355. doi: 10.1017/S0956536117000049
- Inomata, T. (2017b). “The Isthmian Origins of the E Group and Its Adoption in the Maya Lowlands,” in *Maya E Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, eds D. A. Freidel, A. F. Chase, A. S. Dowd, J. Murdock (Gainesville, FL: University Press of Florida), 215–252.
- Inomata, T., Fernandez-Diaz, J. C., Triadan, D., García Mollinedo, M., Pinzón, F., García Hernández, M., et al. (2021). Origins and spread of formal ceremonial complexes in the Olmec and Maya regions revealed by airborne lidar. *Nat. Hum. Behav.* 5, 1487–1501. doi: 10.1038/s41562-021-01218-1
- Inomata, T., MacLellan, J., and Burham, M. (2015a). The construction of public and domestic spheres in the preclassic Maya lowlands. *Am. Anthropol.* 117, 519–534. doi: 10.1111/aman.12285
- Inomata, T., MacLellan, J., Triadan, D., Munson, J., Burham, M., Aoyama, K., et al. (2015b). Development of sedentary communities in the Maya lowlands: Coexisting mobile groups and public ceremonies at Ceibal, Guatemala. *PNAS* 112, 4268–4273. doi: 10.1073/pnas.1501212112
- Inomata, T., Ortiz, R., Arroyo, B., and Robinson, E. J. (2014). *Chronological Revision of Preclassic Kaminaljuyu*, Guatemala: implications for social processes in the southern Maya area. *Latin Am. Antiq.* 25, 377–408. doi: 10.7183/1045-6635.25.4.377
- Inomata, T., Pinzón, F., Palomo, J. M., Sharpe, A. E., Ortiz, R., Méndez, M. B., et al. (2017a). Public ritual and interregional interactions: excavations of the central plaza of group a, Ceibal. *Ancient Mesoam.* 28, 203–232. doi: 10.1017/S0956536117000025
- Inomata, T., and Triadan, D. (2015). “Preclassic Caches from Ceibal, Guatemala,” in *Maya Archaeology 3*, eds C. Golden, S. Houston, and J. Skidmore (San Francisco: Precolumbia Mesoweb Press), 56–91.
- Inomata, T., Triadan, D., Aoyama, K., Castillo, V., and Yonenobu, H. (2013). Early ceremonial constructions at Ceibal, Guatemala, and the origins of lowland Maya civilization. *Science* 340, 467–471. doi: 10.1126/science.1234493
- Inomata, T., Triadan, D., MacLellan, J., Burham, M., Aoyama, K., Palomo, J. M., et al. (2017b). High-precision radiocarbon dating of political collapse and dynastic origins at the Maya site of Ceibal, Guatemala. *PNAS* 114, 1293–1298. doi: 10.1073/pnas.1618022114
- Inomata, T., Triadan, D., Vázquez López, V. A., Fernandez-Diaz, J. C., Omori, T., Méndez Bauer, M. B., et al. (2020). Monumental architecture at Aguada Fénix and the rise of Maya civilization. *Nature* 582, 530–533. doi: 10.1038/s41586-020-2343-4
- Inomata, T., and Tsukamoto, K. (2014). “Gathering in an open space: introduction to mesoamerican plazas,” in *Mesoamerican Plazas: Arenas of Community and Power*, eds K. Tsukamoto, T. Inomata (Tucson, AZ: University of Arizona Press), 3–15.
- Joyce, R. A. (2004). Unintended consequences? Monumentality as a novel experience in formative mesoamerica. *J. Archaeol. Method Theor.* 11, 5–29. doi: 10.1023/B:JARM.0000014346.87569.a4
- King, E. M. (2016). “Rethinking the role of early economies in the rise of Maya states: a view from the lowlands,” in *The Origins of Maya States*, eds L. P. Traxler, and R. J. Sharer (Philadelphia, PA: University of Pennsylvania Museum of Archaeology and Anthropology), 417–460.
- Kosakowsky, L. J. (1987). *Preclassic Maya Pottery at Cuello, Belize, Anthropological Papers of the University of Arizona*. Tucson, AZ: University of Arizona Press.
- Law, I. A., Housley, R. A., Hammond, N., and Hedges, R. E. M. (1991). Cuello: resolving the chronology through direct dating of conserved and low-collagen bone by AMS. *Radiocarbon* 33, 303–315. doi: 10.1017/S0033822200040339
- Lee, D., and Awe, J. J. (1995). “Middle formative architecture, burials, and craft specialization: report on the 1994 investigations at the Cas Pek Group, Cahal Pech, Belize,” in *Belize Valley Preclassic Maya Project: Report on the 1994 Field Season, Occasional Papers in Anthropology*, eds P. F. Healy, J. J. Awe (Peterborough, ON: Trent University), 95–115.
- Lesure, R. G., and Blake, M. (2002). Interpretive challenges in the study of early complexity: economy, ritual, and architecture at paso de la Amada, Mexico. *J. Anthropol. Archaeol.* 21, 1–24. doi: 10.1006/jaa.2001.0388
- Lohse, J. C. (2010). Archaic origins of the lowland Maya. *Latin Am. Antiq.* 21, 312–352. doi: 10.7183/1045-6635.21.3.312
- Lohse, J. C. (2023). “The end of an era: closing out the archaic in the Maya Lowlands,” in *Pre-Mammoth Pottery Variation and the Preclassic Origins of the Lowland Maya*, D. S. Walker (Boulder, CL: University Press of Colorado) 33–56.
- Love, M., and Guernsey, J. (2007). Monument 3 from La Blanca, Guatemala: a middle preclassic earthen sculpture and its ritual associations. *Antiquity* 81, 920–932. doi: 10.1017/S0003598X00096009
- MacLellan, J. (2019a). Preclassic Maya houses and rituals: excavations at the karinel group, Ceibal. *Latin Am. Antiq.* 30, 415–421. doi: 10.1017/laq.2019.15
- MacLellan, J. (2019b). *Households, Ritual, and the Origins of Social Complexity: Excavations at the Karinel Group, Ceibal, Guatemala (Ph.D. Dissertation)*. Tucson, AZ: University of Arizona.
- MacLellan, J. (2019c). Preclassic Maya caches in residential contexts: variation and transformation in deposition practices at Ceibal. *Antiquity* 93, 1249–1265. doi: 10.15184/aqy.2019.129
- MacLellan, J., and Castillo, V. (2022). Between the patio group and the plaza: round platforms as stages for supra-household rituals in early Maya society. *J. Anthropol. Archaeol.* 66, 101417. doi: 10.1016/j.jaa.2022.101417
- Marcus, J. (1998). *Women's Ritual in Formative Oaxaca: Figurine-Making, Divination, Death and the Ancestors, Museum of Anthropology Memoirs*. Ann Arbor, MI: University of Michigan Press.
- Marcus, J., and Flannery, K. V. (2004). The coevolution of ritual and society: new c-14 dates from ancient Mexico. *PNAS* 101, 18257–18261. doi: 10.1073/pnas.0408551102
- McAnany, P. A. (1995). *Living with the Ancestors*. Austin, TX: University of Texas Press.
- McAnany, P. A. (2004). *K'axob: Ritual, Work and Family in an Ancient Maya Village*. Los Angeles, CA: Cotsen Institute of Archaeology, University of California.
- McAnany, P. A., Storey, R., and Lockard, A. K. (1999). Mortuary ritual and family politics at formative and early classic K'axob, Belize. *Ancient Mesoam.* 10, 129–146. doi: 10.1017/S0956536199101081
- Morris, I. (1991). The archaeology of ancestors: the saxe/goldstein hypothesis revisited. *Cambridge Archaeol. J.* 1, 147–169. doi: 10.1017/S0959774300000330
- Munson, J. (2012). *Temple Histories and Communities of Practice in Early Maya Society: Archaeological Investigations at Caobal, Peten, Guatemala (Ph.D. Dissertation)*. Tucson, AZ: University of Arizona.
- Munson, J., and Pinzón, F. (2017). Building an early Maya community: archaeological investigations at Caobal, Guatemala. *Ancient Mesoam.* 28, 265–278. doi: 10.1017/S0956536117000050
- Ortmann, A. L., and Kidder, T. R. (2013). Building mound a at poverty point, Louisiana: monumental public architecture, ritual practice, and implications for hunter-gatherer complexity. *Geoarchaeology* 28, 66–86. doi: 10.1002/gea.21430
- Parker Pearson, M. (1999). *The Archaeology of Death and Burial, Texas AandM University Anthropology Series*. College Station, TX: Texas A&M University Press.
- Pendergast, D. M. (1982). *Excavations at Altun Ha, Belize, 1964-1970*. Toronto, ON: Royal Ontario Museum.
- Pugh, T. W. (2021). Social complexity and the middle preclassic lowland Maya. *J. Archaeol. Res.* 8, 1–14. doi: 10.2021.1007./s10814-021-09168-y
- Reimer, P. J., Austin, W. E., Bard, E., Bayliss, A., Blackwell, P. G., Bronk Ramsey, C., et al. (2020). The IntCal20 northern hemisphere radiocarbon age calibration curve (0-55 cal BP). *Radiocarbon* 62, 725–757. doi: 10.1017/RDC.2020.41
- Ringle, W. M. (1985). *The Settlement Patterns of Komchen, Yucatan, Mexico (Ph.D.)*. New Orleans: Tulane University.
- Ringle, W. M. (1999). “Pre-Classic Cityscapes: Ritual Politics among the Early Lowland Maya,” in *Social Patterns in Pre-Classic Mesoamerica*, eds D. C. Grove, R. A. Joyce (Washington, DC: Dumbarton Oaks), 183–223.
- Robin, C. (1989). *Preclassic Maya Burials at Cuello, Belize, BAR International Series*. Oxford: British Archaeological Reports.
- Robin, C. (2017). “Ordinary people and east-west symbolism,” in *Maya E Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, eds D. A. Freidel, A. F. Chase, S. Dowd, and J. Murdock (Gainesville, FL: University Press of Florida), 361–385.
- Robin, C., Meierhoff, J., Kestle, C., Blackmore, C., Kosakowsky, L. J., Novotny, A. C., et al. (2012). “Ritual in a farming community,” in *Chan: An Ancient Maya Farming Community*, ed C. Robin (Gainesville, FL: University Press of Florida), 113–132.
- Rosenswig, R. M. (2010). *The Beginnings of Mesoamerican Civilization: Inter-Regional Interaction and the Olmec*. New York, NY: Cambridge University Press.
- Rosenswig, R. M. (2021). Opinions on the lowland Maya Late archaic period with some evidence from northern Belize. *Ancient Mesoamerica* 32, 461–474. doi: 10.1017/S0956536121000018
- Rosenswig, R. M., VanDerwarker, A. M., Culleton, B. J., and Kennett, D. J. (2015). Is it agriculture yet? Intensified maize-use at 1000 cal BC in the Soconusco and Mesoamerica. *J. Anthropol. Archaeol.* 40, 89–108. doi: 10.1016/j.jaa.2015.06.002
- Sabloff, J. A. (1975). *Excavations at Seibal, Department of Petén, Guatemala: Ceramics, Memoirs of the Peabody Museum of Archaeology and Ethnology*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.
- Saturno, W. A. (2009). “Centering the Kingdom, Centering the King: Maya Creation and Legitimation at San Bartolo,” in *The Art of Urbanism: How Mesoamerican Kingdoms Represented Themselves in Architecture and Imagery*, eds W. L. Fash, L. López Luján (Washington, DC: Dumbarton Oaks), 111–134.
- Saunders, J., Mandel, R., Sampson, C., Allen, C., Allen, E., Bush, D., et al. (2005). Watson Brake, a Middle Archaic mound complex in northeast Louisiana. *Am. Antiq.* 70, 631–668. doi: 10.2307/40035868

- Saxe, A. A. (1970). *Social Dimensions of Mortuary Practices (Ph.D.)*. Ann Arbor, MI: University of Michigan.
- Schmidt, K. (2010). Gobekli Tepe – the stone age sanctuaries: new results of ongoing excavations with a special focus on sculptures and high reliefs. *Docum. Praehistor.* 37, 239–255. doi: 10.4312/dp.37.21
- Sharpe, A. E. (2019). The ancient shell collectors: two millennia of marine shell exchange at Ceibal, Guatemala. *Anc. Mesoam.* 30, 493–516. doi: 10.1017/S0956536118000366
- Sharpe, A. E., and Aoyama, K. (2023). Lithic and faunal evidence for craft production among the middle preclassic Maya at Ceibal, Guatemala. *Ancient Mesoam.* 34, 407–431. doi: 10.1017/S0956536122000049
- Smith, A. L. (1982). *Excavations at Seibal, Department of Peten, Guatemala: Major Architecture and Caches, Memoirs of the Peabody Museum of Archaeology and Ethnology*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.
- Stanton, T. W., Dzúl Góngora, S., Collins, R. H., and Martín Morales, R. (2022). “Pottery and society during the Preclassic Period at Yaxuná, Yucatán,” in *Framing Complexity in Formative Mesoamerica*, eds L. DeLance, G. M. Feinman (Boulder, CL: University Press of Colorado), 55–85.
- Storey, R. (2004). “Ancestors: bioarchaeology of the human remains of K’axob,” in *K’axob: Ritual, Work, and Family in an Ancient Maya Village, Monumenta Archaeologica*, ed P. A. McNany (Los Angeles, CA: Cotsen Institute of Archaeology, University of California), 109–138.
- Sullivan, L. A., Awe, J. J., and Brown, M. K. (2018). “The cunil complex: early villages in Belize,” in *Pathways to Complexity: A View from the Maya Lowlands*, eds M. K. Brown, G. J. Bey (Gainesville, FL: University Press of Florida), 35–48.
- Tourtellot, G. (1988). *Excavations at Seibal, Department of Petén, Guatemala: Peripheral Survey and Excavation, Settlement and Community Patterns, Memoirs of the Peabody Museum of Archaeology and Ethnology*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.
- Tourtellot, G. (1990). *Excavations at Seibal, Department of Peten, Guatemala: Burials: A Cultural Analysis, Memoirs of the Peabody Museum of Archaeology and Ethnology*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.
- Triadan, D., Castillo, V., Inomata, T., Palomo, J. M., Méndez, M. B., Cortave, M., et al. (2017). Social transformations in a middle preclassic community: elite residential complexes at Ceibal. *Ancient Mesoam.* 28, 233–264. doi: 10.1017/S0956536117000074
- Turner, V. W. (1969). “Humility and hierarchy: the liminality of status elevation and reversal,” in *The Ritual Process: Structure and Anti-Structure*, eds V. W. Turner (Chicago, AL: Springer), 166–203.
- Turner, V. W. (1974). *Dramas, Fields, and Metaphors: Symbolic Action in Human Society*. Ithaca: Cornell University Press.
- Valdez, F., Sullivan, L. A., Butts, P. J., and Aebersold, L. (2021). the origins and identification of the early Maya from colha and northern Belize. *Ancient Mesoam.* 32, 502–518. doi: 10.1017/S0956536121000468
- Walker, D. S. (2023). *Pre-Mamom Pottery Variation and the Preclassic Origins of the Lowland Maya*. Boulder, CL: University Press of Colorado.
- Willey, G. R., Smith, A. L., Tourtellot, G., and Graham, I. (1975). *Excavations at Seibal, Department of Petén, Guatemala: Introduction: The Site and Its Settings, Memoirs of the Peabody Museum of Archaeology and Ethnology*. Cambridge, MA: Peabody Museum of Archaeology and Ethnology.
- Wrobel, G. D., López Pérez, R. A., and Ebert, C. E. (2021). Life and death among the earliest Maya: a review of early and middle preclassic burials from the Maya world. *Ancient Mesoam.* 32, 545–557. doi: 10.1017/S0956536121000456
- Yaeger, J., and Canuto, M. A. (2000). “Introducing an archaeology of communities,” in *The Archaeology of Communities: A New World Perspective*, eds M. A. Canuto, J. Yaeger (London: Routledge), 1–15.



OPEN ACCESS

EDITED BY

Gary M. Feinman,
Field Museum of Natural History, United States

REVIEWED BY

Timothy J. Cheval,
University at Buffalo, United States
Richard Edward Blanton,
Purdue University, United States

*CORRESPONDENCE

Ted L Gragson
✉ tgragson@uga.edu

†These authors have contributed equally to
this work and share first authorship

RECEIVED 22 December 2023

ACCEPTED 30 January 2024

PUBLISHED 16 February 2024

CITATION

Gragson TL and Coughlan MR (2024) The
social-ecological landscape of herding on the
high mountain commons of Larrau in the
western Pyrenees (France).
Front. Hum. Dyn. 6:1359845.
doi: 10.3389/fhumd.2024.1359845

COPYRIGHT

© 2024 Gragson and Coughlan. This is an
open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](#). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic practice.
No use, distribution or reproduction is
permitted which does not comply with these
terms.

The social-ecological landscape of herding on the high mountain commons of Larrau in the western Pyrenees (France)

Ted L Gragson^{1,2*†} and Michael R. Coughlan^{3†}

¹Department of Anthropology, University of Georgia, Athens, GA, United States, ²Laboratoire TRACES, Université Toulouse – Jean Jaurès, Toulouse, France, ³Institute for Resilient Organizations, Communities and Environments, University of Oregon, Eugene, OR, United States

Introduction: Much has been written about herding, pastoralism and the ethos of the commons that persists in Soule and the valley republics of the western Pyrenees. However, more has been written about the idealized norms of the practice than the social dynamics of alliance formation on which cooperation in herding on the high mountain commons in Soule has depended for centuries. We use empirical evidence from the parish-commune of Larrau to analyze the emergence, social alliance, and landscape placement of Cayolar, a syndicate of herders associated with a named inholding within the high mountain commons, to inform our understanding of the process of settling down in the western Pyrenees.

Methods: We abstract the institutional features of herding in the Soule Valley then proceed with a (1) Bayesian analysis of calibrated radiocarbon dates from herding sites across the commons, (2) a Bayesian social network analysis of herders and other alliance-relevant information, and (3) a landscape analysis of the placement of Cayolar inholdings.

Results: A syndicate of herders organized as a Cayolar succeed by following mutually agreed upon rules, making credible commitments to each other, and monitoring members' conformance to the rules. The organizational performance of a Cayolar depends on the articulation of herders to the members of the Soule community of interest through nested levels of institutional decision-making. Archaeological, historical and ethnographic results provide direct evidence for use of Cayolar structures and inholdings by c. 1000 CE and the institutional and organizational aspects of decision-making by c. 1100 CE.

Discussion: The Cayolar is an enduring place-based organization with an average use-span of c. 850 years. Members have a regulatory interest in enforcing the collaboration of others in collective herding and little incentive to defect since unlike Hardin's herders, Cayolar members share a past and expect to share a future as members of the Soule community of interest. Íñigo Arista established the Basque kingdom of Navarra in 824 CE, and his donations contributed to the founding of the Benedictine monastery of Leyre that established a pastoral enterprise at Betzula within the Soule Valley. Other monastic orders soon turned their attention to the western Pyrenees responding to attempts by the Catholic Church to counter civil unrest in southern France. The real turning point for collective herding on the high mountain commons was the introduction of primordial fueros on the Iberian side of the Pyrenees. These direct royal agreements with freemen encouraged resettlement and repopulation of the western Pyrenees and provided the means for local communities of interest to coalesce and develop institutions to organize the collective effort of individuals for the benefit of a group.

KEYWORDS

Bayesian analysis, collective action, radiocarbon dating, social network analysis, vertical transhumance

1 Introduction

Theoretical understanding of the transition from mobile to sedentary lifeways is colored by reliance on a categorical paradigm that is often at odds with empirical evidence pointing to the interplay of individual agency and networks of social affiliation (Feinman and Neitzel, 2023). People are simultaneously social and selfish and, despite decision-making abilities, limited in their ability to process information (Kahneman, 2011; Cronk and Leech, 2013; Thaler, 2015; Feinman and Neitzel, 2023). However, for communities to endure in the face of social and environmental challenges, people must often find new ways to cooperate by forming institutional arrangements. Our contribution on communal herding in the western Pyrenees Mountains and its Medieval antecedents, documents the social and environmental contexts surrounding the emergence and longevity of a cooperative herding institution called a Cayolar that enabled the intensive seasonal exploitation of high mountain pastures. Scholarly understandings of mountain herders, in particular, have been imprisoned by the belief that “...above 1,000 m, there is no history” (Falque-Vert, 1997, p. 9). While archaeology typically depends on material proxies of collective action (Gragson et al., 2020; Feinman and Neitzel, 2023; Quirós Castillo et al., 2023), in this paper, we relate archaeological evidence of land use and settlement to ethnographic and historical evidence of the less tangible institutional and organizational aspects of how Basque herders overcome conflicts of interests and issues of coordination.

It has been suggested that the creation of upland pastures in the western Pyrenees was an abrupt transition resulting from rapid, intentional landscape conversion in alignment with conventional archaeological periods (Rius et al., 2009; Galop et al., 2013). Such satisfyingly simple explanations are often based on a single archive, the opinion of a single agent, or the population inferred from an SPD of calibrated radiocarbon dates (Coughlan, 2015; Gragson and Thompson, 2022). Our results-to-date in the western Pyrenees and that of others in comparable mid-elevation mountain settings suggest the agropastoral niche emerged across Europe through a slow, non-linear, cumulative and persistent press linked to social processes that are still under debate (Arnold and Greenfield, 2006; Gragson et al., 2020; Quirós Castillo et al., 2023). Netting’s (1972, 1976, 1981) seminal work in the community of Törbel documented cooperative mountain agropastoralism as a static and bounded end point in the effort to find a sustainable balance between community and environment. There are clear similarities and important differences between Basque agropastoralism in the western Pyrenees and that described by Netting in the Swiss Alps. The comparative value of these two cases (and others on mountain agropastoralism) is how they inform our understanding of individual agency, the surprising solutions communities of interest can arrive at to overcome social dilemmas, and how these improve our ability to explain phase shifts such as settling down.

Olson (1965) initiated the first period of collective action inquiry by challenging the assumption that individuals would voluntarily form alliances to the benefit of a group. His contribution was framed by market theory and considered how a perfectly rational individual with perfect information (i.e., *Homo economicus*) would make a decision about collaborating with others using objective costs and benefits. This challenged many to offer empirical examples of selfish individuals incurring personal costs

to coordinate with others for the benefit of a group (McCay and Acheson, 1987; Feeny et al., 1990; McCabe, 1990; Smith and Wishnie, 2000) and marked the start of the second period of collective action research spearheaded by Ostrom (1990). She recognized that rationality was contingent rather than absolute and showed in case-after-case how individuals combined costs and benefits with shared norms and opportunities in a subjective calculus to reach a decision about whether or not to collaborate with others. This served to shift attention away from the internal calculus to the situational variables conditioning an individual’s decision-making. These variables included attributes of the resource system, the resource units, and the resource appropriators including the social facilitators of collective action such as the willingness of individuals to accept personal costs to punish a free rider (Van Zomeren and Iyer, 2009; Cronk and Leech, 2013; Jagers et al., 2020; Thomas et al., 2020).

Ostrom (1990) frequently used Netting’s example of Törbel to illustrate what she referred to as the design principles of collective action. It is nevertheless important to recognize that Netting (1972, 1976, 1981) framed his study in light of contemporary issues in ecological anthropology. This included identifying cybernetic regulatory mechanisms to socially enforce conservation and equitably share the benefits of communal effort. Netting added historical and demographic dimensions to the inquiry as these were largely ignored in ecological anthropology investigations at the time. The value of Netting’s contribution is without question yet there are conceptual, methodological, and analytical means available now to investigate the processes of change and collective action across time (Thompson et al., 2018; Feinman and Neitzel, 2020; Quirós Castillo et al., 2023) that were not available when Netting pioneered the study of how the people of Törbel balanced on an alp.

We begin our study of Basque communal herding by abstracting from diverse sources how the Cayolar as both an organization and a structure is embedded geographically and socially in several decision-making levels within the Soule Valley. Using original data we collected in the parish-commune of Larrau we: (1) Evaluate the use of Cayolar structures through a Bayesian analysis of calibrated radiocarbon dates from herding sites across the commons constrained by cadastral and other historical records. (2) Examine the social alliance of herders in Cayolar organizations through a Bayesian social network analysis of herders and other alliance-relevant information extracted from cadastral and voter records. (3) Examine the placement of Cayolar inholdings in the landscape using field-collected GPS data, cadastral records and a digital elevation model. In our concluding discussion, we combine the institutional, historical, archaeological and landscape evidence to understand how it conditions the agency and alliance of herders on the high-mountain commons and then drawing from several sources identify the antecedents for governing the commons in the western Pyrenees.

1.1 Setting and context

This study of Basque herding is based in the Soule Valley (Xiberoa, in Souletin Basque hereafter SB) on the north-facing western Pyrenees Mountains (Figure 1). It is the smallest of the three Basque Provinces in France with a territory of 785 km²

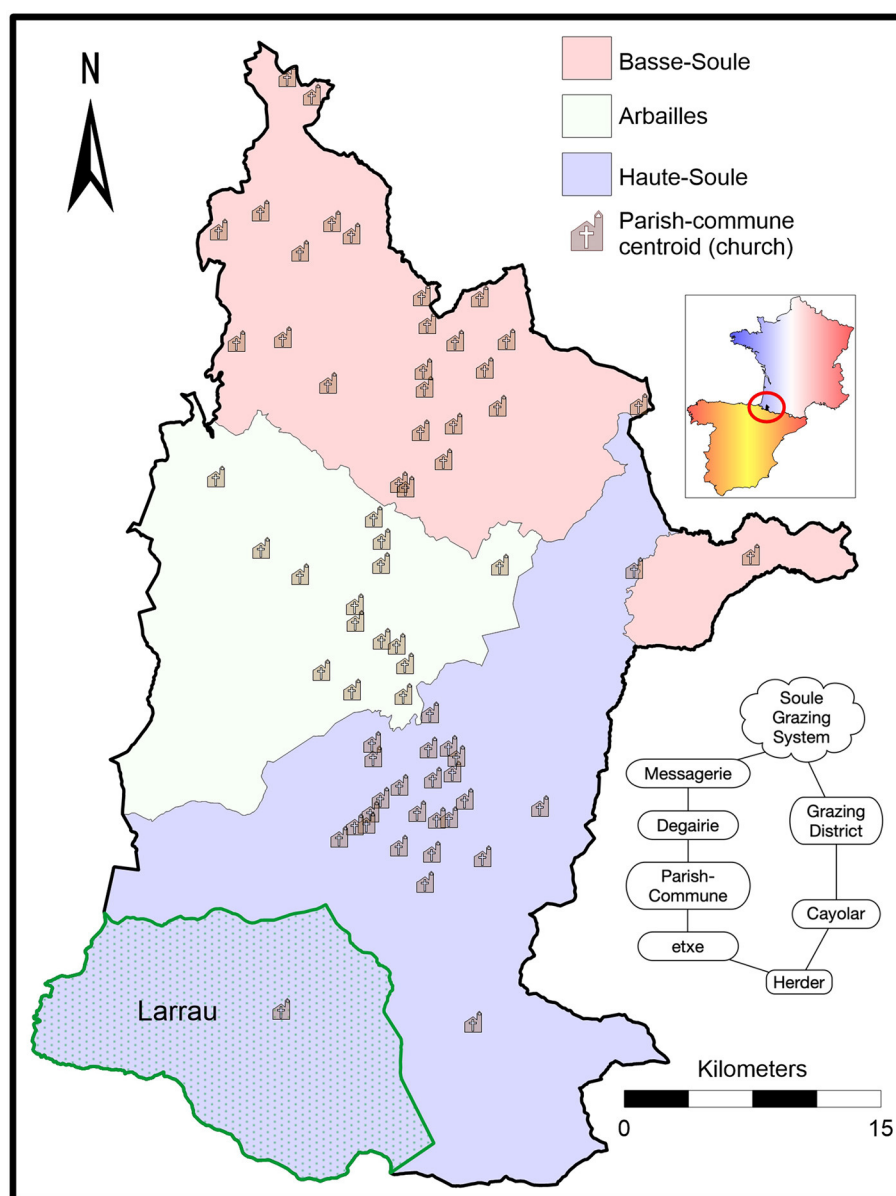


FIGURE 1

Soule Valley with location of parish-communes and the lower, middle and upper provinces into which the valley is divided, and the conceptual relation (insert panel) between named geographic elements associated with the Soule grazing system.

centered on the axis of the Saison River where we have conducted place-based investigations for several years on the onset and progression of pastoralism above 800 masl. The western Pyrenees Mountains form the hinge between the Ebro River Valley to the south and the Aquitanian Plain to the north. They are central not only to the agropastoral domestication of European landscapes but the rise and fall of renowned lords and kings in their battles for control over people and territory. Our investigations in the Soule Valley include stratigraphically sampling slope wash deposits (i.e., colluvium from zero-order watersheds) back to the Late Pleistocene ca. 20,000 BCE to recover multiproxy evidence for landscape fire (Leigh et al., 2015, 2016). We have also carried out ethnographic and historic research on the use of pastoral fire to manage common grazing lands as well as the processes of land use change and

household abandonment (Coughlan, 2013; Coughlan and Gragson, 2016; Coughlan et al., 2022).

The use of high-mountain pastures in the Soule Valley can be summarized as a summer event recurring from time-out-of-memory that involves hundreds of Basque herders from dozens of villages across the valley converging with thousands of sheep on to the commons in the parish-commune of Larrau. The sheep consume grass which they transform into milk that the herders transform into cheese. Much has been written about herding and pastoralism in the western Pyrenees beginning with the well-known accounts by Lefebvre (1928, 1933) and Cavailès (1931a,b). Ott (1993) conducted research on the parish-commune of Saint Engrâce bordering the parish-commune of Larrau, both located within the Soule Valley. None of these works substantively address

the process of herders forming alliances to the potential benefit of the 30,000 inhabitants in the Soule Valley living in 68 towns in the early 19th century. Törbel, by comparison, is a single closed-corporate community with a maximum population of about 700 in 1950 CE.

The Coutume de Soule first published in 1521 CE (Grosclaude, 1993) and older documents divide the Soule Valley into community lands and common lands. Community lands are enclosed within the defined boundaries of a parish-commune centered on a church. Common lands generally lie above 800 masl and consist of open rangeland and forest areas only available to residents of parish-communes within the Soule Valley (Noussy Saint-Saëns, 1955).

The parish-commune of Larrau contains 62% (9,257 ha) of the high common rangelands in Soule, and elevations that range from 300 to 2,000 masl. Flatter lands in the lower elevations (300–800 masl) contain the hamlet of Larrau centered on the parish church with houses, businesses and administrative buildings clustered around it. Privately held agricultural parcels are concentrated in the flatter areas peripheral to the hamlet. Steeper lands between 800 and 1,300 masl contain communal woodlands and heathlands as well as fragmented private inholdings (*borda*, SB). Named households (*etxe*, SB) owning the *borda* use them to harvest hay for feeding and bracken for bedding livestock in the winter (Palu, 1992; Gragson et al., 2020). Lands above 1,300 masl are the alpine and subalpine common grasslands and heaths used by herders from throughout the Soule Valley. Only residents of Soule have access to the communal summer pastures and only those who are members of a Cayolar have a right to graze sheep in the grazing districts.

Before turning to details of herding on the commons in Soule, we provide succinct definitions of relevant terms based on key collective action sources (Olson, 1965; North, 1990; Ostrom, 1990; van Zomeren et al., 2008; Van Zomeren and Iyer, 2009; Cronk and Leech, 2013; Jagers et al., 2020; Thomas et al., 2020). Collective action means action taken by two or more individuals to improve the status, power, or influence of a group, while a collective action dilemma (or collective action problem or social dilemma) refers to factors limiting collective action. Limitations to collective action are most commonly the result of individuals free-riding on the efforts of others or a failure to coordinate the action of individuals. For the former limitation, individuals cannot be excluded from the benefits that others provide so they are unmotivated to contribute to the effort themselves. In contexts involving common-pool resources such as open grasslands used for grazing, resource units removed from the common-pool reduce the quantity available for others yet the characteristics of the resource pool (e.g., size, etc.) limit the possibility of excluding potential beneficiaries. The failure to coordinate results from the uneven distribution of information and knowledge across individuals resulting in conflicts of interest between them as they attempt to find the solution to a social dilemma.

Individuals resolve collective action problems by either (a) supplying a new set of institutions, i.e., constraints that shape social interaction often expressed in the form of rules, (b) making credible commitments to those they cooperate with and/or (c) mutual monitoring to ensure everyone “follows the rules.” These solutions require shared, common knowledge that translate to individual collaborators knowing the rules, knowing their collaborators know

the rules and knowing their collaborators know they know the rules. Such rules are classified as operational, collective, and constitutional:

- Operational choice rules: these are the day-to-day decisions made by appropriators about when, where, and how to withdraw resource units, who should monitor the actions of others and how, and what information must be exchanged along with the rewards or sanctions allocated to actions and outcomes.
- Collective choice rules: these are rules used by appropriators, officials or external authorities in making policies about how a common poor resource should be managed.
- Constitutional choice rules: these rules determine who is eligible to participate in operational activities and which rules will be used to craft collective choice rules that in turn affect operational rules.

1.2 Institutional features of herding

A Cayolar is a syndicate of herders associated with a named inholding that serves as a gateway to the common lands surrounding it [Cayolar is a Gascogne word used in French equivalent to Olha in Souletin Basque and rendered as Kaiolar in Standard Basque (Ott, 1993; Barandiaran and Manterola, 2000)]. The inholding itself minimally contains a stone-walled and wood-roofed shelter (either a hut or a barn) used by the herders, a corral to hold the sheep and is generally near water (Figure 2). The most frequently referenced description of a Cayolar is from the 1521 Coutume de Soule (Grosclaude, 1993) with additional details derived from other sources (Lefebvre, 1933; Noussy Saint-Saëns, 1955; Ott, 1993; Etchegoyhen, 2012). Cayolar members participate in the syndicate by contributing a share (*txotx*, SB) equal to a finite, partible number between 45 and 60 head of milch ewes. The *txotx* is in fact the “purchase price” of a proportional title to the inholding. It is thus a credible commitment to the other members of the organization that the herder will follow the norms of the syndicate. The fundamental norm being that the herder assures the other members that they will contribute a flock of sheep equal in size to their *txotx*.

To achieve success in operating a Cayolar herders must: (a) supply a set of rules they agree to follow, (b) make credible commitments to each other, and (c) mutually monitor members’ conformance to the rules (Ostrom, 1990). The appropriators must trust each other to succeed. As all are inhabitants of the Soule Valley, their shared history and expected future together substantially reduces each individual’s future discount rate to collaborate in the present. Cayolar organizational performance is assured by the articulation between individual herders and the population of the Soule Valley through a set of nested spatial-institutional levels.

1.2.1 Operational choice level

A Cayolar organization consists of individual herders combining their share of sheep into a single flock. Individuals bear the personal costs and reap the collective benefits from



FIGURE 2

Cayolar shepherd huts: (A) Historic shepherd hut with stream course in the background, (B) Contemporary shepherd hut with storage shed visible to its immediate left and its associated holding pen/milking shed downslope to the left.

cooperating to manage the sheep flock, make cheese and carry out the other tasks that assure success of the syndicate. The Cayolar is a durable organization typically involving two or more herders acting openly as a legal person in that they own assets and produce goods for consumption or sale (Coase, 1937; Hodgson, 2001). Day-to-day decisions by the members of the Cayolar are made in light of a series of operational rules that minimize the problems of self-interest with guile and coordination.

The rules include meeting about March 25 (Catholic Feast of the Annunciation) to make decisions about infrastructure maintenance on the inholding, the dates the herders will move

the sheep up and back from the Cayolar inholding, the work rotation of herders during the cheese-production season and the number of cheese rounds they will produce (Noussy Saint-Saëns, 1955; Goyheneche, 1973; Ott, 1993; Etchegoyhen, 2012). The members meet a second time around 22 July (Catholic Day of Saint Madeline) at the end of the cheese-production season to divide up the expenses and profits. The sheep are shorn then moved to higher common rangelands. The sheep are finally brought down from the commons in mid- to late-October and divided into the original share-flocks (Goyheneche, 1973; Richer, 1998).

1.2.2 Collective choice level

Named *etxe* (SB) stem family households were the fundamental unit of production and decision-making in Soule and an enduring solution to subsistence, marriages, births, deaths, and the aging process of individuals (Coughlan and Gragson, 2016). The *etxe* is a spatially fixed, real-property stock consisting of a house, barns, tools, etc. conceptually distinguished by Souletin Basque from the family using the stock to produce a flow of resource units. The distinction is evident in that *etxe* can “die” while the family lives on and symmetrically an *etxe* can “live” on even after the family bloodline ends (Arrizabalaga, 1997). The normative stem family consists of two couples respectively from the parental and the inheritor generation, their spouses and their unmarried siblings and offspring living under one roof. The two couples at the root of the family are collectively referred to as masters of the house (*maîtres de maison*, French hereafter FR), and when necessary distinguished as old master (*maître vieux*, FR) and young master (*maître jeune*, FR) (Lafourcade, 2003).

Basque stem family inheritance rules are primogeniture and impartibility of the estate (Arrizabalaga, 2005): the eldest male or female child inherits the entire estate and the right to form a family. Törbel households were simple or single-family production units adhering to the western Alpine tradition of partible inheritance (Netting, 1981). In Soule, the younger siblings of the *maître jeune* inheriting the estate stayed on as celibate members beholden to the decisions of the inheritor (Grosclaude, 1993; Arrizabalaga, 1997). The *maîtres de maison* thus operationalized the rhythms of the family life cycle comprised of different generations and their associated capacities for work and consumption. The herder aligned with other herders in a Cayolar organization represented the interests of a named *etxe* as expressed by the *maîtres de maison*, and the *txotx* the herder used as a stake to participate in the organization was drawn from the stock of the *etxe*.

1.2.3 Constitutional choice level

All native inhabitants of Soule were free and without servitude obligations, while the Valley was defined as a “pays de franc-alieu naturel et d’origine” (FR) (Grosclaude, 1993; Lafourcade, 2010a,b). In approximate translation, the land was free from other titles, most importantly royal titles, undeveloped, and ancestral to those currently inhabiting it; the inhabitants themselves formed a community of interest (*pays*, FR) with allodial title to all lands within the geographic limits of the Soule Valley summarized in the adage, “nul seigneur sans titer” or no lord/master without a title (Lefebvre, 1928; Dalla-Rosa, 1984; Poumarede, 1984; Lafourcade, 2006). A “native inhabitant” of Soule was defined in the Coutume as one holding land (*heritage*, FR) which placed them under the law (*ressortissant*, FR) comprised of choice rules at different levels including those operational and collective rules mentioned above.

Constitutionally, parish-communes held the right to assemble and manage their own affairs including the establishment of rules to manage and protect forests, vacant lands, livestock and legal matters within the boundaries of the parish-commune. The interests of parish-commune inhabitants were represented by the *maîtres de maisons* (either the old or the young, but not both)

who met each Sunday to discuss and take decisions on matters concerning the parish-commune. Among these were ensuring compliance with the rule contained in the Coutume stating that the number of livestock a member of the community of interest could graze on the commons was limited to the number an *etxe* was able to winter-feed with hay and straw derived from its private lands within the boundaries of the Soule Valley. Parish-communes were typically divided into neighborhoods (*quartier*, FR) (Coughlan and Gragson, 2016). The *maîtres de maison* delegated execution of small decisions to a secular clergyman (*maire abbé*, FR) and two elected representatives from each *quartier* while taking direct responsibility for those matters likely to incur a second-order collective dilemma. For example, the *maîtres de maisons* designated tax assessors (*cotisateurs*, FR) in each *quartier* to determine the fiscal tax burden of each *etxe*, yet appointed a tax collector (*fermance vezalier*, FR) from among themselves to collect the tax.

Parish-communes were organized into seven districts (*degairie* or *vic*, FR) that in turn were organized into three provinces (*messagerie*, FR). Once per year on May 1, the *maîtres de maisons* from all parish-communes within a *degairie* would cast lots to elect a *degan*. All *maîtres de maison* from one parish-commune within the *degairie* (the parish-commune rotated annually) stood to be elected and was expected to serve or else pay a fine equal to one beef per day until the position was filled. The *degan* coordinated the parish-commune tax collectors and received the tax from them, managed the district affairs of interest to the inhabitants and liaised with provincial officers overseeing construction and maintenance of roads and bridges along with public safety and security. The *Silviet* operated at the inclusive level of the entire Valley and consisted of a general assembly of all *maîtres de maisons* from every parish-commune. As a group they were responsible for managing the communal lands, had authority to extend 4-year concessions to individuals for clearing land and harvesting wood on the commons, authority to levy *corvée* for public works, and enter into contracts (*faceries*, FR) with adjoining valleys on the south-facing Pyrenees for use of communal pastures.

We turn next to an evaluation of the use of Cayolar structures, membership and alliance in Cayolar organizations and placement of Cayolar inholdings in the parish-commune of Larrau.

2 Data

Our evidence consists of radiocarbon dates from the features and areas associated with named Cayolar structures, membership records for all named Cayolar operating on common lands of Soule within the boundaries of the parish-commune of Larrau c. 1830 CE, and spatial attributes of the placement of Cayolar inholdings in the commons.

2.1 Cayolar structures

We conducted an archaeological pedestrian survey of ~4,710 hectares of pastures above 800 m asl during which we located



FIGURE 3
Anchors of pastoral activity in Soule recorded archaeologically: (A) shepherd hut, (B) watering trough, (C) livestock enclosure, (D) tertres.

42 sites and associated surface features used in seasonal herding activities excluding Cayolar huts still actively used in herding (Champagne et al., 2014). Surface features included small mounds called *tertre*, livestock enclosures or corrals and stone foundations of shepherd huts (Figure 3). *Tertre* are ~2 m in diameter at the base and 1 m high; corrals have variable dimensions and consist of bermed earth, bedrock, or stacked stone structures with an opening at one end. Shepherd hut foundations are morphologically consistent with extant though not modern shepherd huts and are roughly rectangular alignments of rocks measuring ~6 (range: 4.5–8 m) by 4 m (range: 3–5.6 m).

We used a 10 cm bucket auger to sample the soil profile at 10 cm intervals within and adjacent to huts, corrals and *tertres* at each site and screened each sample at 0.45 and 0.2 mm to recover cultural material and macro-charcoal for dating. Forty-eight radiocarbon samples were recovered from seven, widely distributed sites and submitted for dating to the Center for Applied Isotope Studies (UGA). Multiple ^{14}C samples were obtained from each site but no sample provided more than one date. Samples were processed following a standard protocol with $^{14}\text{C}/^{13}\text{C}$ ratios measured with a 0.5 MeV accelerator mass spectrometer and $^{13}\text{C}/^{12}\text{C}$ ratios measured separately on a stable isotope ratio mass spectrometer. Table 1 lists the details on the archaeologically recovered samples.

2.2 Cayolar membership

We discovered in examining cadastral documents in the archives of the Department of Pyrénées-Atlantiques (Pau, France) a supplement to the 1830 Napoleonic Cadaster titled “co-owners of indivisible otherwise ‘collective’ property.” The supplement is not dated, but cross-referencing the named Cayolar members with other records indicate the supplement dates between 1830 and 1832 CE. Soule faced a series of legal and fiscal challenges between the fall of the Napoleonic Empire in 1814 CE and the creation of the Commision Syndicale du Pays de Soule in 1838 CE and it seems the supplement was compiled to support claims by or against the parish-commune of Larrau.

The supplement contains comprehensive information on 68 named Cayolar operating on the commons in the parish-commune of Larrau and 231 Cayolar members from 35 parish-communes within the Soule Valley. Nine Cayolar are identified as the property of a parish-commune leased or rented to an *ad hoc* group of herders from one parish-commune. Twenty-three Cayolar are owned by a single individual who is sometimes indicated as renting out the property and in others is recorded as a nobleman or a public official who most likely also rented out the property. While a Cayolar refers to an organized group of herders, in this article we use the term owner/herder since 32 entries in the supplement indicate an owner for the inholding but not the individuals using the inholding.

TABLE 1 Uncalibrated AMS dates in radiocarbon years before 1950 CE (years BP) using the 14C half-life of 5,568 years and one standard deviation reflecting both statistical and experimental errors.

UGAMS#	SiteNo	SiteName	SampDepth	Mat	$\delta^{13}\text{C},\text{‰}$	Years BP	$\pm$	pMC	± 2
19014	42	Anchologuia	40–50	Wood	−26.2	270	25	96.67	0.28
19015	42	Anchologuia	30–40	Wood	−25.8	350	20	95.72	0.26
19016	42	Anchologuia	20–30	Wood	−25.8	870	20	89.72	0.25
19017	42	Anchologuia	20–30	Wood	−25.9	970	20	88.57	0.25
21150	42	Anchologuia	11	Char	−26.2	180	20	97.73	0.27
21151	42	Anchologuia	33	Char	−24.9	420	20	94.95	0.26
21155	42	Anchologuia	38	Char	−24.2	870	20	89.70	0.25
21156	42	Anchologuia	7	Char	−20.4	590	20	92.86	0.27
65645	42	Anchologuia	10–20	Char	−22.4	330	20	95.96	0.26
65646	42	Anchologuia	20–30	Char	−23.7	750	20	91.07	0.26
23473	41	Burustola Upper	10–20	Char	−27.7	250	35	96.87	0.44
23474	41	Burustola Upper	40–50	Char	−26.3	250	25	96.93	0.28
23475	41	Burustola Upper	10–20	Char	−26.9	140	20	98.21	0.28
65642	41	Burustola Upper	10–20	Char	−26.9	180	20	97.78	0.26
65643	41	Burustola Upper	20–30	Char	−25.2	570	20	93.16	0.26
65644	41	Burustola Upper	30–40	Char	−23.6	150	20	98.12	0.26
21153	3	Ibarandoua (locus 3)	33	Char	−25.8	330	20	95.95	0.27
65631	3	Ibarandoua (locus 3)	10–20	Char	−26.4	260	20	96.81	0.26
65632	3	Ibarandoua (locus 3)	20–30	Char	−25.5	660	20	92.09	0.25
65633	3	Ibarandoua (locus 3)	30–40	Char	−26.8	1,630	20	81.67	0.22
19018	27	Ibarandoua (locus 4)	30–40	Wood	−24.9	310	20	96.21	0.27
19019	27	Ibarandoua (locus 4)	20–30	Wood	−24.3	300	20	96.37	0.27
19020	27	Ibarandoua (locus 4)	30–40	Wood	−26.8	340	20	95.82	0.27
19021	27	Ibarandoua (locus 4)	50–60	Wood	−27.2	700	25	91.68	0.26
21152	27	Ibarandoua (locus 4)	23–34	Char	−27.0	160	20	97.96	0.27
65638	27	Ibarandoua (locus 4)	10–20	Char	−23.3	300	20	96.34	0.26
65639	27	Ibarandoua (locus 4)	20–30	Char	−25.2	720	20	91.42	0.25
65640	27	Ibarandoua (locus 4)	40–50	Char	−25.2	230	20	97.11	0.26
65641	27	Ibarandoua (locus 4)	60–65	Char	−26.5	310	20	96.15	0.26
23477	37	Ihitsaga	10–20	Char	−27.0	60	20	99.19	0.28
23479	37	Ihitsaga	30–35	Char	−25.4	220	20	97.26	0.27
65652	37	Ihitsaga	20–30	Char	−26.1	200	20	97.51	0.27
23470	71	Malta	10–20	Char	−26.3	90	20	98.86	0.28
23471	71	Malta	40–50	Char	−27.2	150	20	98.20	0.28
65650	71	Malta	10–20	Char	−26.9	180	20	97.78	0.26
65651	71	Malta	20–30	Char	−25.8	110	20	98.61	0.26
23472	55	Pista Gagnekoa	10–20	Char	−24.4	230	25	97.16	0.28
23478	55	Pista Gagnekoa	40–50	Char	−26.3	110	20	98.65	0.28
65647	55	Pista Gagnekoa	20–30	Char	−11.1	570	20	93.15	0.26
65648	55	Pista Gagnekoa	30–40	char	−25.8	130	20	98.40	0.26
65649	55	Pista Gagnekoa	50–60	char	−23.1	110	20	98.66	0.26

(Continued)

TABLE 1 (Continued)

UGAMS#	SiteNo	SiteName	SampDepth	Mat	$\delta^{13}\text{C}_{\text{‰}}$	Years BP	±	pMC	±2
19022	5	Ugnhurritze	90–100	Wood	−25.8	720	30	91.42	0.37
19023	5	Ugnhurritze	60–70	Wood	−25.9	410	20	95.00	0.26
23476	5	Ugnhurritze	20–30	Char	−26.3	150	25	98.16	0.30
65634	5	Ugnhurritze	110–120	Char	−25.9	840	20	90.10	0.25
65635	5	Ugnhurritze	110–120	Char	−26.9	970	25	88.61	0.27
65636	5	Ugnhurritze	80–90	Char	−23.4	810	20	90.43	0.25
65637	5	Ugnhurritze	90–100	Char	28.1	120	20	98.48	0.26

SampDepth in cm.

2.3 Cayolar inholdings

We obtained coordinates for waterways, parish-commune boundaries and village church centroids from the BD Carto (IGN) thematic map series then verified and modified the information to match the information from the 1830 Napoleonic Cadaster. We obtained parish-commune name variants and membership in districts and provinces from [Orpustan \(2010\)](#) Nouvelle Toponomie Basque and the Basque Onomastics Database ([Euskaltzaindia, 2022](#)). We georeferenced the locations of Cayolar inholdings and the footprint of shepherd huts either during the pedestrian survey or from the digitized maps from the 1830 Napoleonic Cadaster. We combined all placement information into an ArcGIS analytical geodatabase.

3 Analysis

We present below the relevant details of our methods and results from the analysis of dated radiocarbon samples from Cayolar structures, the social network analysis of Cayolar membership records, and the placement of Cayolar inholdings in the common grazing lands.

3.1 Structure chronology

We investigated two different chronological models using OxCal version 4.4.4 and the IntCal20 calibration curve ([Bronk Ramsey, 2009](#); [Reimer et al., 2020](#)). We conditioned the models to constrain date ranges ([Hamilton and Krus, 2018](#)) using our knowledge of the landscape and stratigraphic context of samples. We set the site abandonment date (i.e., *terminus ante quem*, TPQ) either to 1829 CE for sites that had been abandoned at an unknown date prior to the 1830 CE cadaster otherwise we used the site's known, post-1829 CE abandonment date. We consider a model to be significant when the A_{model} and A_{overall} values >60 , and the convergence value (C) $>95\%$ ([Bronk Ramsey, 1995](#); [Manning and Birch, 2022](#)), and report dates in calendar years CE rounded to the nearest 5 years.

In [Figure 4](#) we provide a summary of the dates using kernel-density estimation (KDE) with default parameters ([Bronk Ramsey, 2017](#)) that shows they span 705 and 915 years ($p = 95.4\%$) with a distinctly bimodal distribution with peaks at c. 1300 CE and c. 1700

CE ($A_{\text{model}} = 90.9$, $A_{\text{overall}} = 92.2$, and $C > 97.2$). We excluded one sample (65633) that dates between 405 and 540 CE ($p = 95\%$, $C = 97.5$) as it derives from the deepest sampled stratigraphic position at the site and may represent landscape burning rather than site use. In [Figure 5](#) we present the results of our simple bounded-phase chronological model ([Bronk Ramsey, 2009](#)), which again excludes sample 65633 and sets the end-of-phase to 1958 CE when the last site in this set was abandoned. Dates in this model ($A_{\text{model}} = 88.6$, $A_{\text{overall}} = 88.3$, and $C > 99.2$) are assumed to derive from a continuous activity phase that began between 1035 and 1150 CE ($p = 95\%$, $C > 99.2$). The use-phase lasted between 805 and 920 years with a median duration of 850 years. The distribution is again bimodal with a break between the peaks at c. 1450 CE. The KDE and simple bounded-phase model results are very similar giving us confidence in the overall duration and the general shape of the distribution.

[Figure 6](#) contains the results of our bounded overlapping phase model that assumes the occupational phases of individual sites are independent and possibly overlapping. This allows us to estimate the start date and end date of use for each site. We constrained site use in this model to begin between 840 and 850 CE (contains the 842 CE founding date of Leyre Monastery discussed below) and the last possible date each site was abandoned. This robust model ($A_{\text{model}} = 89.2$ and $A_{\text{overall}} = 90.5$, and $C > 95.9$) provides greater chronological control on each site yet still aligns with the results of the KDE and simple bounded-phase model.

3.2 Social networks

We previously used UCINET ([Borgatti et al., 2002](#)) to analyze the three interdependent sub-networks of the Soule herding network ([Gragson et al., 2021](#)) and characterize its structural features: (a) any herder selected at random can reach any other herder in the network irrespective of village of residence or Cayolar membership; (b) any herder selected at random is connected to more than half the total number of herders participating in the herding network; and, (c) there is no “central authority” determining where individual herders reside, who they form alliances with, or the sheep share they contribute. In summary, each sub-network as well as the overall network form a densely knit, tightly bound valley-wide structure, yet the sub-networks and the overall network are socially emergent rather than autocratically directed.

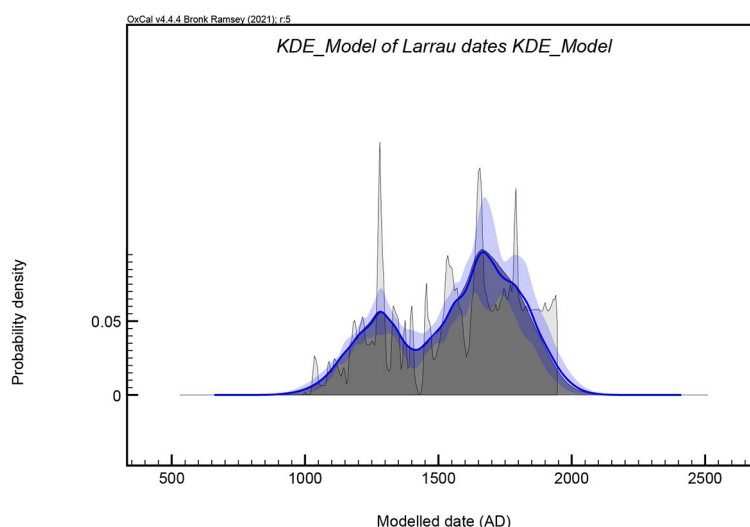


FIGURE 4

Kernel-density estimate summarizing 47 dates from seven high elevation pastoral sites. Red crosses (left) show median uncalibrated ^{14}C ages and black crosses (below) the median modeled calibrated dates. Gray crosses (below) represent median calibrated dates before KDE modeling. The relevant section of the IntCal20 calibration curve is shown for reference.

Here we use Exponential Random Graph Modeling (ERGM) to analyze the joint probability of edges connecting an owner/herder to a named Cayolar. The data are organized as a bipartite, 2-mode network. Unlike two, one-mode projections of the same data, the bipartite network accounts for ties forming between the individuals in the network who come from multiple parish-communes and are in partnership in more than one Cayolar. We analyze the network using ERGM 4.5.0 (Krivitsky et al., 2003–2022, 2023; Goodreau, 2007) dependent on R (>4.1) (R Core Team, 2013) and running in RStudio (RStudio Team, 2015). ERGM is a bottom-up, actor-based analysis framework sensitive to the non-independence of two nodes linked by an edge (Kenny et al., 2006) which treats the social network as a dependent variable of one or more independent conditions. The estimated coefficients are log-odds ratios of establishing a network tie conditional on the rest of the network (Goodreau, 2007). ERGM offers a stronger basis for interpreting how social networks form than the descriptive measures available in UCINET (Wasserman and Pattison, 1996; Robins et al., 2001; Goodreau et al., 2009; Snijders et al., 2010; Wang et al., 2013).

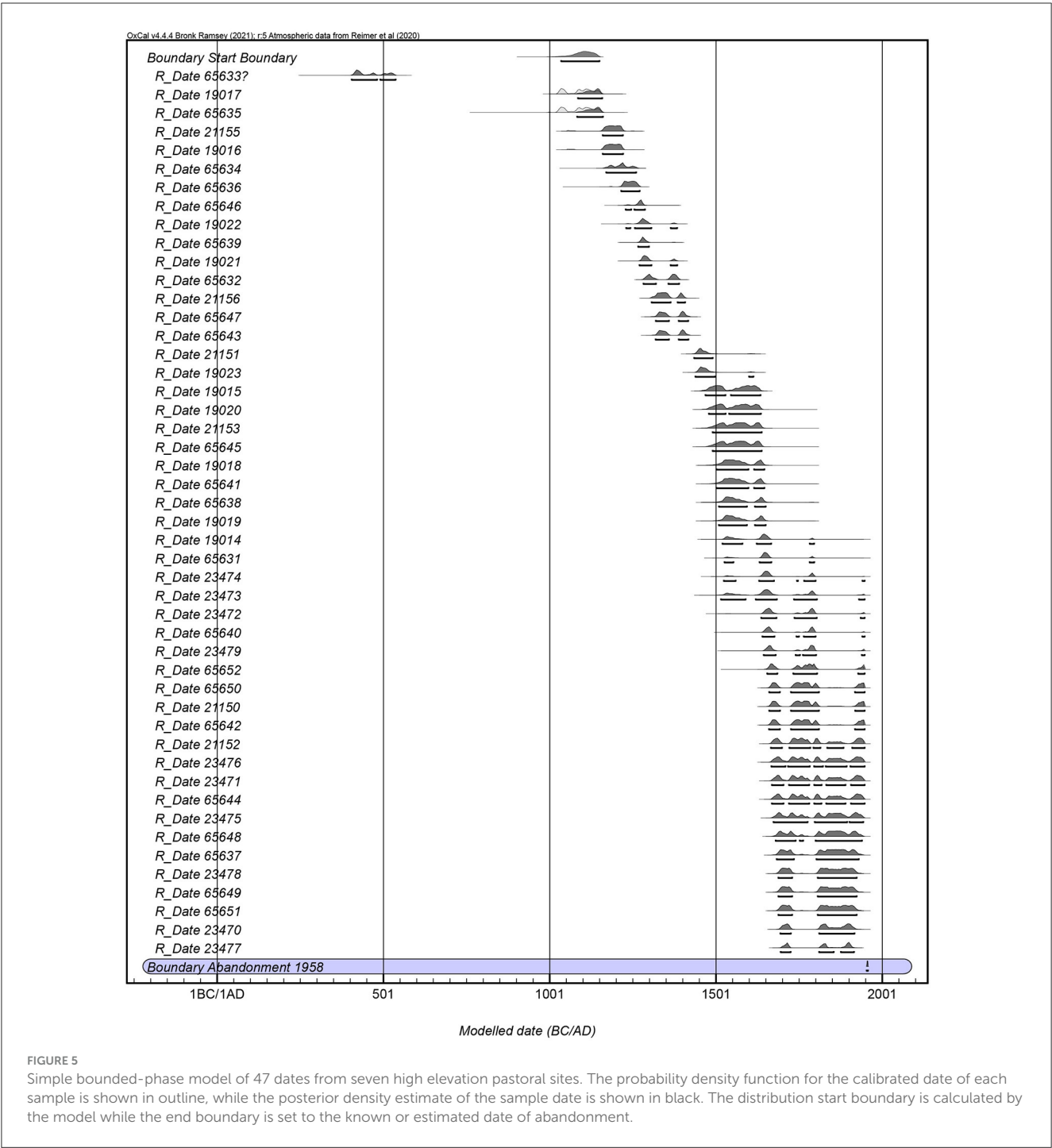
The bipartite network consists of 231 owner/herder nodes and 68 Cayolar nodes joined by 270 edges (Figure 7) that we condition by the (a) parish-commune ($n = 34$), (b) degairie ($n = 7$), and (c) messagerie ($n = 3$) an owner/herder is associated with. Fifty-five percent of all parish-communes, and 100% of all degairie and messagerie in Soule are represented in the network. We tested the fundamental question that needs to be asked about any association of two or more individuals: do the groups observed differ from the groups that might result by chance alone. We performed the test by treating the observed network as a single observation from the distribution of all possible networks with the same number of nodes (Robins et al., 2007), then fit the dataset to the Erdős-Rényi random graph model in which each edge appears independently and with equal probability. Figure 8 is a representative graph from

the model run that shows numerous unaffiliated owner/herders even though in the actual network every individual is affiliated with at least one Cayolar. The edges coefficient (-4.03) indicates the Erdős-Rényi model is a poor fit to the empirical network, which is further demonstrated by the inverse logit of θ with $p = 0.02$ of a tie forming between any two individuals through their common membership in a Cayolar.

The simple reason for the poor fit is that ties in the empirical network beyond that of two individuals through a single Cayolar (i.e., two-star) are dyad-dependent (Figure 9) whereas ties in the Erdős-Rényi model are equiprobable. Once two individuals are allied in the empirical network, the probability of a third joining them (i.e., three-star) is a dependent probability of the first two. The widely reported number of herders needed to organize a Cayolar is seven (i.e., seven-star) yet the empirical network ranges from one-star (single individual) through 13-star (13 members) with a strong clustering of observed cases between four and eight-star and a simulated median value c. four. The parsimonious model we identified for the observed distribution of joint probability ties is that more individuals from the same parish-commune organize into a Cayolar than expected by chance alone. This result rests on the statistically significant and positive $b_{\text{lnodematch}}$ estimate of 0.607, equivalent to $p = 0.65$ of a tie forming between any two individuals from the same parish-commune. This result amounts to a test of the social principle of homophily (i.e., sociality, ethnicity) in which individuals form alliances with other individuals with similar attributes.

3.3 Inholding placement

The 1830 CE cadaster lists 122 inholdings within the commons associated with 68 named Cayolar. The shape and size of inholdings ranges from 0.1 ha to 167 ha with a median of 8.4 ha. As a rule,



inholdings held by one individual or organized group of individuals are on the small end of the size distribution whereas inholdings held by a parish-commune are larger and include both the typical infrastructure of a Cayolar inholding as well as rangeland used for sheep grazing. Some named Cayolar furthermore comprise two or three separate inholdings at different elevations that are distinguished by suffixes to the name of the Cayolar: *Pekoa-Olha* (lower), *Arteko-Olha* (middle), and *Gaineko-Olha* (upper) (Lefebvre, 1928). Twelve named Cayolar organizations in the Soule Valley operated from three inholdings at different elevations,

22 operated from two inholdings at different elevations, and 32 operated from one inholding.

Inholdings are further distinguished by whether they contained structures taxed as shepherd huts (*cabane*, FR $n = 95$) or structures taxed as barns (*grange*, FR $n = 17$). These are mutually exclusive types of inholdings and there are no instances of a Cayolar inholding having both a shepherd hut and a barn. We then evaluated landscape position of inholdings overall and relative to the number of inholdings per Cayolar using a 5 m² resolution digital elevation model (DEM) by taking the elevation of the

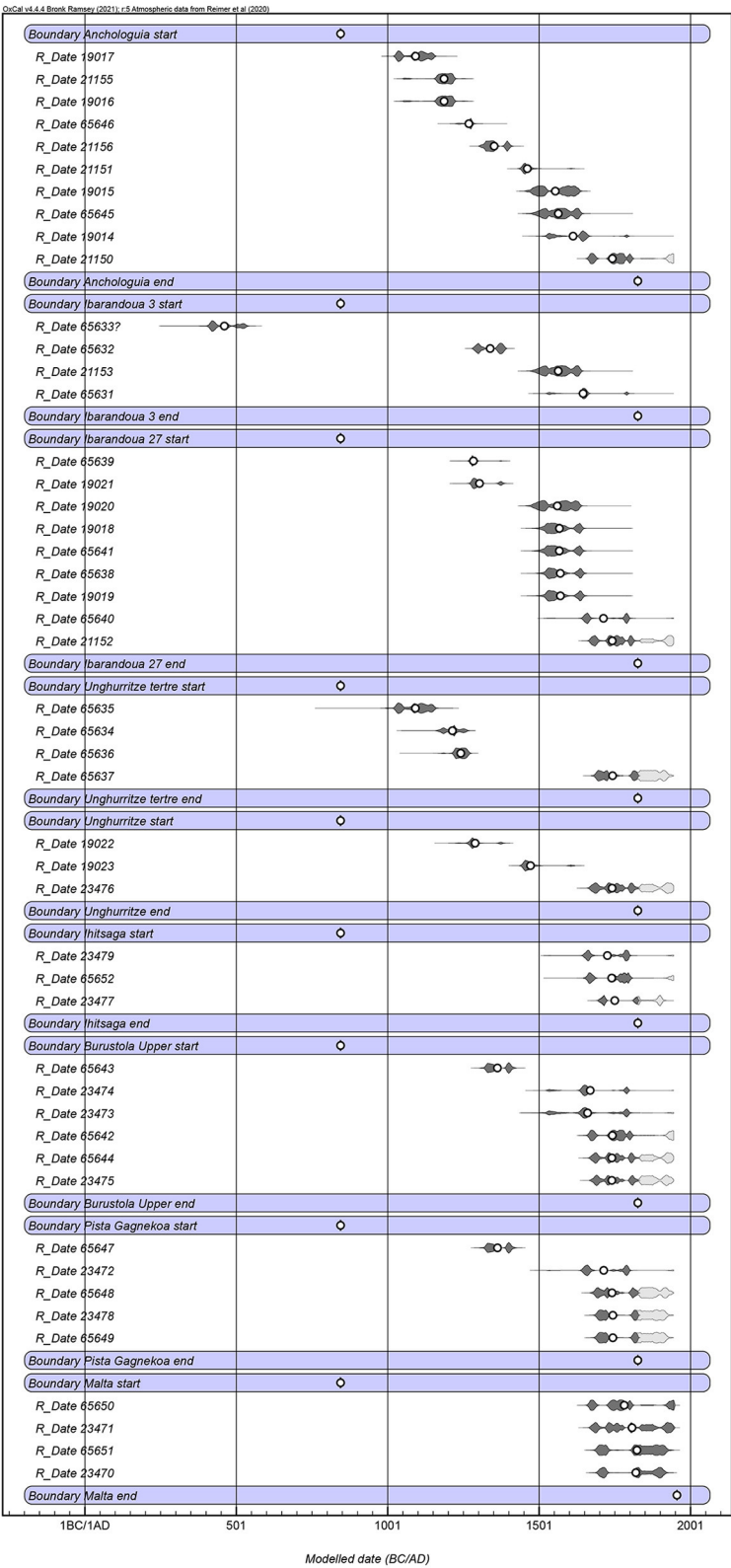


FIGURE 6
Bounded overlapping phases model of 47 dates from seven high elevation pastoral sites. The probability density function for the calibrated date of each sample is shown in outline, while the posterior density estimate of the sample date is shown in black. The start boundary for all distributions is set to 840–850 CE, while the end boundary is set to known or estimated *terminus anti quem* date of abandonment of each site based on cadastral records.

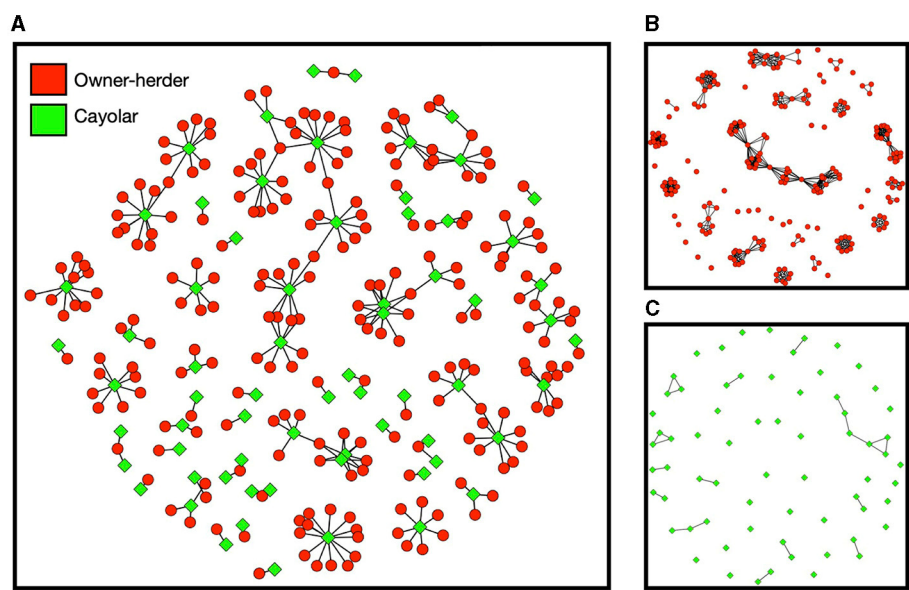


FIGURE 7
Bipartite owner/herder $\times$ Cayolar network consisting of 231 herders from 34 parish-communes associated with 68 named Cayolar distributed across four grazing districts: **(A)** empirical bipartite network, **(B)** one-mode projection of owner/herders linked through common membership in at least one Cayolar, **(C)** one-mode projection of Cayolars linked by having at least one owner/herder in common.

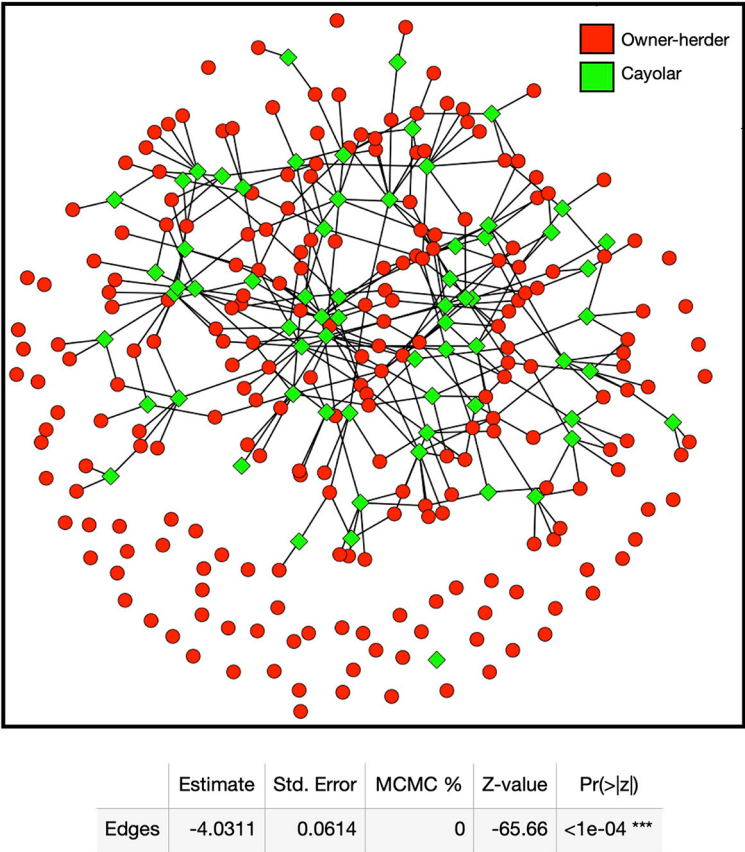
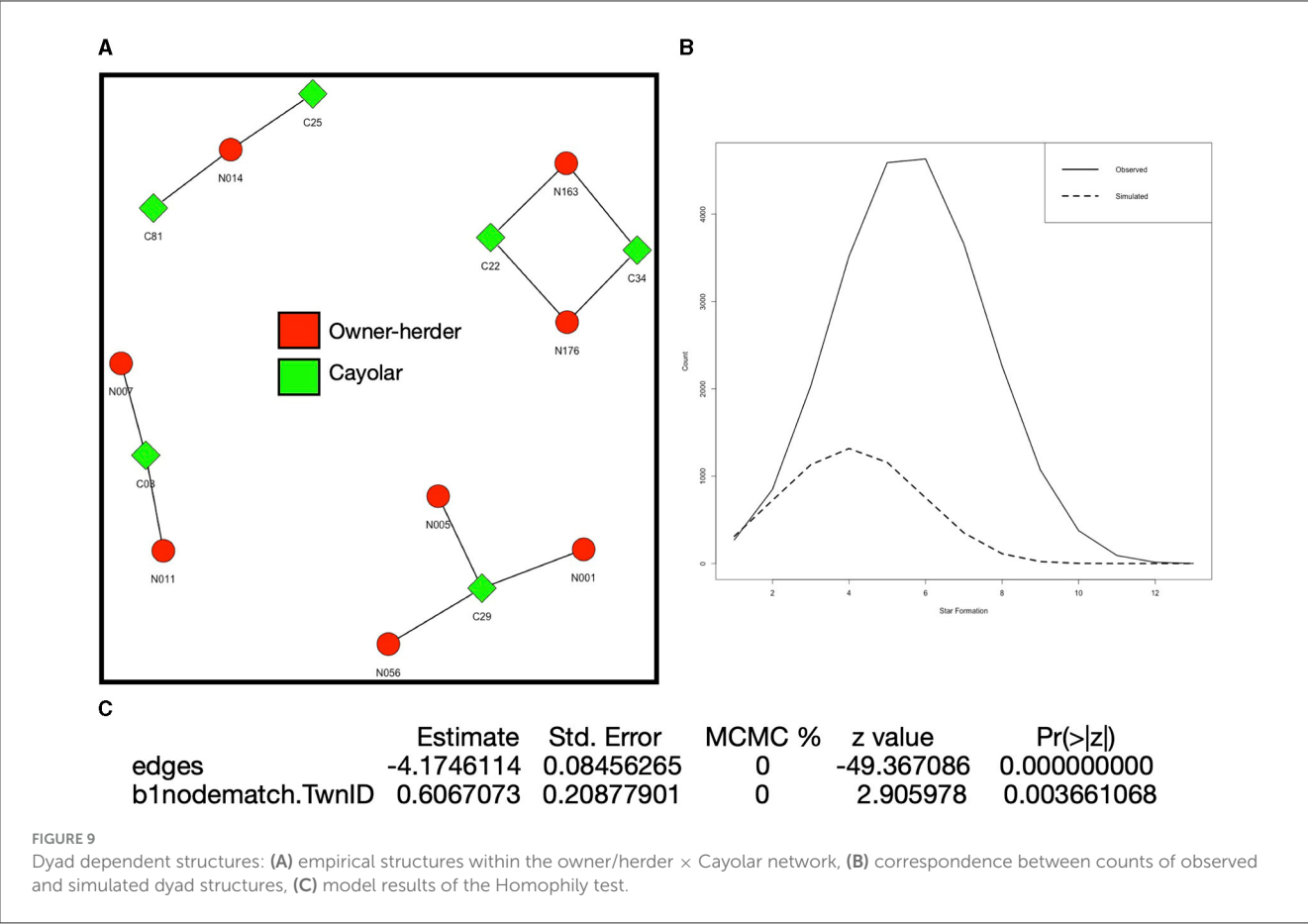


FIGURE 8
One realization of the Erdős-Rényi random graph model based on the properties of the observed network along with the log-likelihood estimate of the fit based on all model runs (AIC = 2,723; BIC = 2,731).



shepherd hut or the barn on the inholding (Table 2). Without distinguishing the number of inholdings or type of structure, Cayolar are located at a mean elevation of 1,192 masl (range: 1,497–689 m). This is well above the mean elevation of etxe or barns that are part of fragmented etxe inholdings within communal woodlands and heathlands (i.e., Borda). There are no significant differences between the absolute range in elevation values of shepherd huts or barns for Cayolar operating from one, two or three inholdings other than the tendency for a narrowing of the elevation range for each elevation class as the number of inholdings per Cayolar increases.

However, there is significant unexplained elevational overlap in Borda vs. Cayolar inholdings that is both subtle and largely invisible archaeologically. Indeed, both Borda and Cayolar occur as inholdings within the heathland commons and while Borda are always associated with barns, they sometimes have huts; while most Cayolar are associated with huts, some instead have barns. The main differences between the two inholdings are difficult to parse archaeologically either by *ownership* (Borda are held by individual etxe and Cayolar are held by a collective) or *use* (Borda barns are used to shelter animals and to store hay from their associated meadows while Cayolar barns are used for shelter only). To evaluate the differences between these two types of inholdings, we used ArcGIS Pro 3.2 and the 5 m² DEM to calculate slope and construct a topographic position index (i.e., deviation from mean elevation) both resampled to a 250 m window (De Reu et al., 2011). We then calculated distance to nearest stream and the amount of pasture vs.

other land use types recorded in the 1830 cadaster (Coughlan, 2014) within 250 m of private Borda barns and Cayolar huts and barns. These were then used as independent variables in a simple binomial Generalized Linear Model analysis in SPSS v.29 of differences between the two farming infrastructures (Cayolar = 1, Borda = 0). Significant variables in our model include elevation, slope (250 m), and access to pasture within 250 m (Table 3). Cayolar as a class are on higher, steeper terrain with greater access to pasture than Borda even when limiting the analysis to the elevational zone in which Cayolar and Borda co-occur (c. 640–1,050 m asl).

4 Discussion

Collective herding in France and the work of authors such as Lefebvre (1933), Noussy Saint-Saëns (1955), Ott (1993), and Etchegoyhen (2012) lie within a national debate that predates by centuries the French Revolution. The debate centers on the normative and rational role of the state in managing the selfish and unruly behavior of individuals (Vivier, 1998; Testart, 2003). Legal experts sought to suppress collective enterprises like the Cayolar because they viewed them as an obstacle to modernization and tried demonstrating that collective herding led to failure in pastoral production. Social historians in turn, promoted such collective enterprises as exemplars of a lifestyle insulated from the damaging effects of modernity and tried to demonstrate their productive success (Bloch, 1930a,b; Vivier, 1998; Testart, 2003). Neither side,

TABLE 2 Elevational attributes of Etxe farmhouses, Borda barns, and Cayolar huts.

<i>n</i>	Infrastructure	Type	Structure type	Mean	SD	Max	Min	Range
178	Etxe	Private	House or house with barn	629	92	886	333	553
226	Borda	Private	Barn	686	139	1,026	344	682
116	Cayolar	Syndicate/private/communal	All	1,192	174	1,497	689	808
70	Gaineko Olha	All Cayolar	All	1,215	177	1,497	739	758
46	Pekoa Olha	All Cayolar	All	1,158	166	1,480	690	790
12	Gaineko-Olha	3-inholding Cayolar	Hut	1,300	68	1,426	1,206	220
12	Arteko-Olha	3-inholding Cayolar	Hut	1,240	59	1,333	1,127	206
12	Pekoa-Olha	3-inholding Cayolar	Hut	1,024	150	1,235	690	545
17	Gaineko-Olha	2-inholdings Cayolar	Hut	1,284	131	1,489	939	551
17	Pekoa-Olha	2-inholdings Cayolar	Hut	1,191	156	1,480	926	554
25	Olha	1-inholding Cayolar	Hut	1,194	197	1,497	740	758
7	Olha	1-inholding Cayolar	Barn	971	61	1,055	896	158
5	Gaineko-Olha	2-inholdings Cayolar	Barn	1,247	200	1,411	990	421
5	Pekoa-Olha	2-inholdings Cayolar	Barn	1,136	222	1,326	824	502

“n” = number of observations in the cadastral dataset. Type indicates type of infrastructural arrangement, elevation expressed in meters above sea level.

TABLE 3 Results of binomial GLM for Cayolar (1) vs. Borda (0).

Variable	<i>B</i>	SE	Sig. (<i>p</i> -value)	Exp(<i>B</i>)
Pasture within 250 m	0.242	0.076	0.001	1.273
Slope (mean 250 m window)	0.356	0.109	0.001	1.427
DEV (250 m window)	0.178	0.858	0.835	1.195
Euclidian distance to streams	−0.007	0.004	0.059	0.993
Elevation (meters above sea level)	0.031	0.017	<0.001	1.032

Significant variables shaded.

however, gave much attention to the empirical reality of how herders collectively coordinated their actions in or through time across complex social-ecological landscapes.

4.1 Alliance formation

The Cayolar organization is the day-to-day operational unit of pastoral activity on the high mountain commons in the Soule Valley. The nested assembly levels of free houses represented by the *maîtres de maisons*, however, hold the authorities of supply, commitment, and monitoring of collective action on the commons (Ostrom, 1990). While the regime operates within the framework outlined in the Coutume de Soule published in 1521 CE during the reign of Francis I (1515–1547 CE), this is not a “pure” Basque institution of governance. The western Pyrenees were incorporated into the administrative structure of the Kingdom of France in 1461 CE during the reign of Louis XI (1461–1483 CE). The institutional details in the Coutume were assembled in response to a 1483 CE royal order that charged royal representatives to record oral and

customary practices (not impose normative French law) from all local communities of interest across the realm.

The organizational principals contained in the Coutume, if not always the details, are common to Aragonese, Basque, Béarnaise and Gascogne valley communities either side of the western Pyrenees Mountains. Like Soule, these valley communities are recognized as customary countries—*pays coutumier* in France and *comunidad de villa y tierra* or *comunidad de aldeas* in Spain. The first written accounts of oral tradition and customary practice in this region (called coutume in French and fuero in Spain) date to the 12th century (Noussy Saint-Saëns, 1955; Lefebvre, 1963; Cursent, 1998; Vivier, 1998; Fernández Mier and Quirós Castillo, 2015). A unique period document (Urrutibéhéty, 1983) from a court case on August 1, 1455 CE, references a public ordinance from August 15, 1395 CE that stipulates the inhabitants of Larrau were exempt from tribute and had free use of forests and pasturelands since the establishment of Larrau in 1174 CE.

There is also proxy material evidence of the Soule Valley institutional framework in the form of legacy structures. For example, the National Convention of 31 October 1793 CE suppressed parish-communes across France and created the

communes still used today. When geometricians collected the field information to develop the national cadaster, in nearly every case in southern France and with known certainty in Soule, they simply recorded the geographic properties of the existing parish-communes, agricultural parcels, commons, etc. (Clergeot, 2007; Motte and Vouloir, 2017). At least five parish-communes in the Soule Valley have been in existence since the 11th century CE, and all parish-communes and many *etxe* with their associated stem families have been stable since at least 1377 CE (Noussy Saint-Saëns, 1955; Urrutibéhéty, 1983; Cierbide, 1994). The earliest record of a Cayolar operating on the commons within the territory of the parish-community of Larrau dates to 1024 CE and it has operated continuously up through the present on the same inholding and under the same name (Coughlan et al., 2023). The first mention of the Silviet dates to the 13th century (Noussy Saint-Saëns, 1955, p. 339; Lafourcade, 2010b).

The Cayolar organization in Soule lies within a class of pastoral institutions common to the western Pyrenees and Cantabrian mountains, and comparable institutions identified among mountain herders across Europe (Poumarede, 1984; Couturier, 2000; Agnoletti, 2007; Bordessoule, 2007). These pastoral institutions take the form of an annually iterated *n*-person public goods assurance game in which the contribution of each member is essential to the production of resource units. The most obvious resource units produced by members of a Cayolar organization are sheep wellbeing and cheese, but a variety of secondary benefits also derive from this alliance of herders (e.g., friendship, assistance-in-time-of-need, etc.). A Cayolar is an enduring place-based organization as demonstrated by our chronology from multiple sites across the commons indicating a use-span of 850 years for the infrastructure on Cayolar inholdings. Rarely is documentary evidence for the use of a Cayolar inholding available much before the 16th century with the occasional exception as the just noted Cayolar that has been operating for 1,000 years (Coughlan et al., 2023).

Cayolar organizations endure because the members have a regulatory interest in enforcing the contribution of others in the collective herding efforts and little incentive to defect since they must trust each other to cooperate (Heckathorn, 1996; Kitts, 2006; Takács et al., 2008). Hardin (1968) parable speaks to the conflicts of interest and challenges of coordination that undermine cooperation among herders leading to a future tragedy for all as each individual overexploits the grazing commons in the present. Unlike Hardin's herders, herders in a Cayolar share a past and expect to share a future as members of the Soule Valley community of interest. More immediately, each herder represents an *etxe* that holds proportional title to the Cayolar and contributes the sheep share the herder is cooperatively managing with the other members of the organization. Herders in both instances attribute less value to future benefits than they do to present benefits. However, Hardin's herders exist in the moment and discount the future so severely that they choose to capture all their benefits in the present. The Cayolar herders, on the other hand, do not discount the future as severely and are willing to forgo some present benefits because they or the members of their *etxe* can be expected to benefit in the future. The Cayolar herders are also likely to have other opportunities to benefit by virtue of the alliances they have with the other members of the Cayolar.

Our homophily test parallels the logic of how discount rates and the tradeoffs between present vs. future benefits influence a herder's decision to collaborate with others. Homophily, sociality and ethnicity are traditionally viewed as the global property of a population and thus unsuitable for explaining the agency of individuals or the alliances they form with others. ERGM reveals how an aggregate phenomenon such as homophily emerges from the tendency of variably conditioned individuals to form links with similarly conditioned neighbors (Granovetter, 1978; Goodreau et al., 2009). Netting (1981) offers a reduced set explanation for affiliation in collective herding in the Swiss Alps that is equally applicable to Cayolar herding in Soule: herders depend on each other to avoid labor shortages that would arise if households were forced to tend their own herds alone.

As for the placement of Cayolar inholdings, the results do not confirm but they do suggest the Cayolar organization emerged as a way to govern grazing lands unsuitable for the cultivation of crops or storable forage. Theory suggests that elevational constraints guide the settlement ecology of household vs. collectively owned farming infrastructure (Rhoades and Thompson, 1975; Netting, 1981). We previously analyzed parcel land use change and *etxe* abandonment between 1830 and 1958 CE (Coughlan and Gragson, 2016). The results reveal the complex processes by which *etxe* farmhouses within the Borda zone were functionally repurposed as Borda in response to changing socioeconomic conditions. There is no hard rule governing what constitutes high pasture or which terrain falls under the purview of the Cayolar institution. Temporal variability in elevational constraints on farming are climate-driven and subject to change, thus, the degree of elevational co-occurrence of the two institutions suggests flexibility over time in whether a place functioned as a Cayolar or a Borda. Figure 10 summarizes elements of this spatial flexibility in the Cayolar system.

4.2 Collective action antecedents

There are no indigenous Basque accounts before the 9th century CE and the few period documents that do refer to the Basque are often written by individuals in open conflict with them (Larrea, 1998, p. 114). While there is physical, documentary and proxy evidence for Cayolar-based herding at high elevation in Soule beginning c. 1000 CE, neither we nor others have yet to identify structural remains conclusively associated with pastoralism above 800 masl prior to this date. We previously established that charcoal production associated with the establishment and maintenance of pastures above 800 masl in Soule increases dramatically after 1000 CE following a production hiatus that began c. 1000 BCE (Coughlan et al., 2023). The increase in charcoal production occurs in tandem with the establishment of farming households below 800 masl organized into neighborhood communities (Coughlan and Gragson, 2016; Gragson et al., 2021).

The well-known accounts of pastoralism by Lefebvre (1928, 1933), Cavallès (1931a,b), Ott (1993) and others largely limit their analysis of the Cayolar organization to the operational level (Ostrom, 1990). When pastoralism is further colored by the debate between legal experts and social historians the organization is both taken out of time as well as separated from evidence about

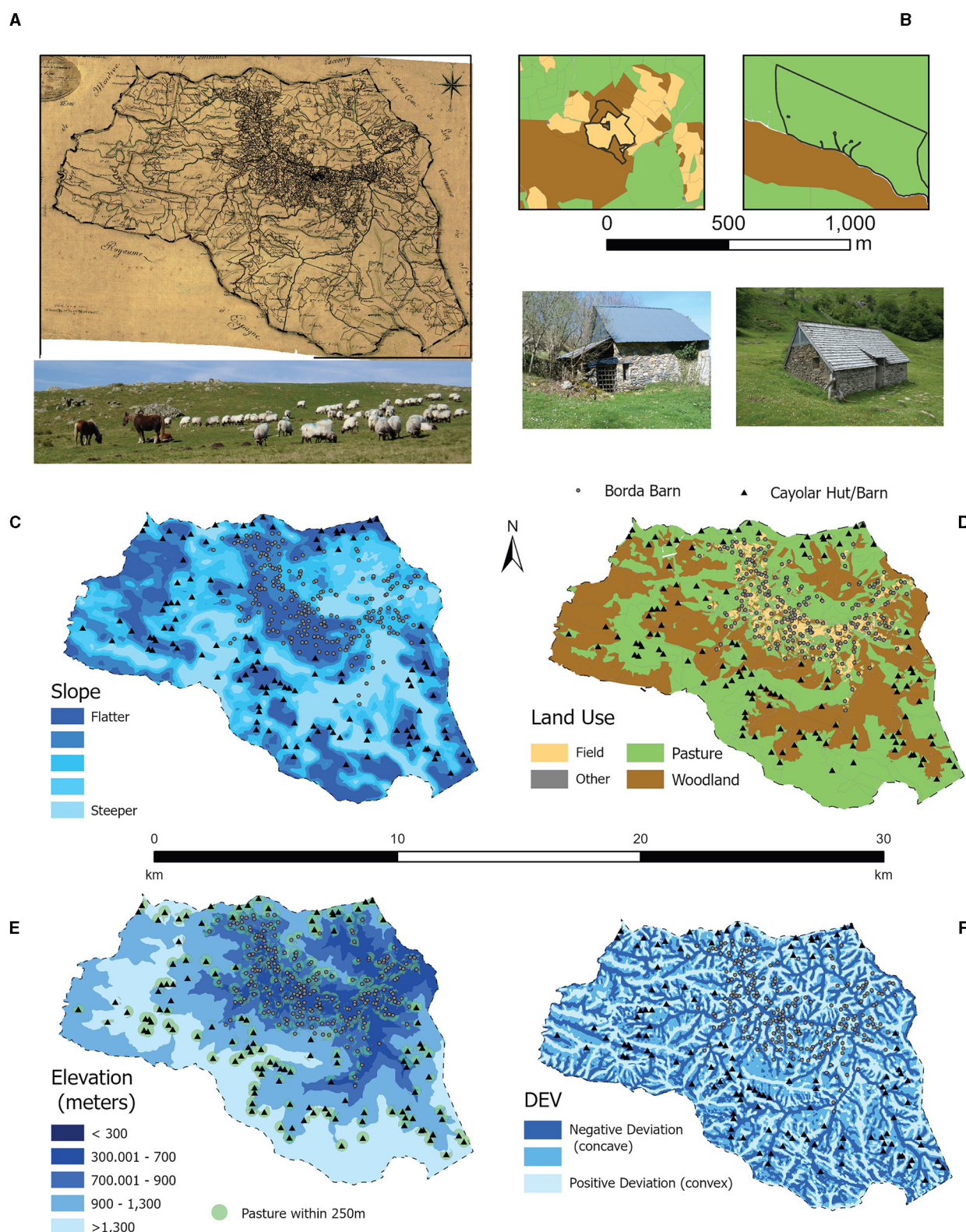


FIGURE 10
Data layers used in the generalized linear model analysis of Cayolar and Borda structures. **(A)** 1830 cadaster with digitized parcels, **(B)** examples of Borda parcel inholdings (upper left) and barn (lower left), and Cayolar parcel inholdings (upper right) and hut (lower right), **(C)** slope, **(D)** land use ca. 1830, **(E)** elevation in meters above sea level, **(F)** deviation from mean elevation. Cayolar locations indicated by black triangle and Borda locations indicated by gray circles in maps **(C–F)**.

individual agency and affiliation networks so that it is not possible to understand the endurance of this organization over time. Ostrom shattered the conviction that local collective dilemmas could only be solved by external authorities imposing private property and centralized regulation. The emergence and persistence of Basque institutions for self-regulating grazing of the commons reveal their capacity to shape and reshape the situations in which individuals make day-to-day decisions and bear the consequences of their actions. This is precisely the space we need to consider in order to investigate the process of change over time in collective action.

Documentary evidence indicates that Basque settlement was impacted over time by military activity at the onset of the Roman era in 180 BCE, the Germanic invasions beginning c. 400 CE, military action between Franks, Visigoths and Vascones along with Bagaude/brigand marauding between 500 and 700 CE, and the Moorish invasion of 711 CE (Larrea, 1998). Major Basque settlements starting in Antiquity such as Pamplona and Calahorra were on the plains adjacent to the Ebro River while extensive agropastoral activities were concentrated in the pre-Pyrenees valleys of Guipuzcoa and the inland territory of Álava (Larrea, 1998; Martín Duque, 2002a; Pavón Benito, 2018; Quirós Castillo, 2020). After 700 CE, Basque expanded their territory from the Ebro Basin in Iberia across the western Pyrenees to the Aquitaine Plain in France, which was then referred to in period documents as Guasconia (Fredegar, 1981). Shortly thereafter, the Ravenna Cosmographer (Anonymous, 1860) produced the first map showing Basque lands as spanning the Pyrenees up to the Adour-Ouse River corridor in France.

After the Basque defeated the Carolingian army at the Second Battle of Roncevalles in 824 CE, Íñigo Arista established the Basque kingdom of Navarra: c. 5,000 km² centered on Pamplona with close ties to the Catholic Church against their common enemy, the Moors (Martín Duque, 2002b; Pavón Benito, 2018). Íñigo Arista set the course for reopening the Soule Valley to agropastoral use by making donations that combined with donations from Wilesindo, Bishop of Pamplona, led to the establishment in 842 CE of the Benedictine monastery of Leyre (in Navarra). Few details are available, but Leyre is known to have operated a significant pastoral enterprise in the small valley of Bezula within the territorial limits of what would become the parish-commune of Larrau (Brocas and Legaz, 2005). The monastery of Leyre was later acquired by Cistercian monks who with subsequent land donations initiated large scale sheep herding in the mountain reaches of the kingdom of Navarra including Soule. The Cistercian monks from Leyre were followed into Soule by Cistercian monks from the Sauvelade Abbey in the lower reaches of the Soule Valley in France while other monastic orders established themselves in the western Pyrenees in areas surrounding the Soule Valley (Cursent, 1994; Larrea, 1998; Unzu Urmeneta, 2021).

Following a series of land donations with grazing rights for large and small livestock, Larrau was established in 1174 CE as a priory of the Cistercian Abbey of la Sauvelade; the church of Sanctus Johannes de Larraun was built in 1193 CE as a chapel for the ospitau de Larraun that served as the nucleus of what would become the parish-commune of Larrau (Urrutibéthy, 1983). Our chronology and documentary evidence for Cayolar-based activities on the commons within the territorial limits of the parish-commune

of Larrau pre-date by over 150 years the construction of the church and establishment of the population center of Larrau. Understanding the process of settling down in the western Pyrenees and Europe have been intellectually dominated by the argument that agropastoral spaces are the inevitable consequence of first establishing a hamlet, village or town. The sequence of events in Larrau and comparable settings in northern Iberia such as Tobillas (Quirós Castillo et al., 2023) point to just the opposite. It is land use and management activities that lead eventually to the materialization of alliance in the form of a settlement and its social institutions.

The understanding of settling down even when individual agency and alliance networks are acknowledged has been colored by assumptions about the length of time it must take for such a phase shift to occur. However, without refined chronologies we deny people their history and render them powerless (Whittle, 2018). Monasteries turned their attention to the Pyrenees Mountains as the Catholic Church issued its “Peace of God” policy in response to the civil unrest that had prevailed in southern France since at least 840 CE from the abuses perpetrated by the landed gentry on the peasantry. One consequence of the policy was the establishment of safe-have (*sauvete*, FR) churches, towns, and castles that guaranteed safety to fugitives (e.g., Sauvelade Abbey).

While safe havens were developing to the north of the Pyrenees Mountains in France, there were equally significant events unfolding to the south in Iberia. The collapse of the Califate of Cordoba in 1032 CE led to the emergence of multiple taifas (i.e., Moorish kingdoms) who paid an annual protection tax (*paria*, Spanish) in gold to Christian kingdoms such as Navarra. King Sancho Ramirez of Aragón and Pamplona (1042–1094 CE) and king Alfonso VI of Castilla (1040–1109 CE) used this tax to underwrite the Fuero de Jaca and the Fuero de Estella. These primordial fuero encouraged resettlement and repopulation of the Pyrenees Mountains by creating safe corridors through the mountains (Martínez González, 2012) and reducing the initial cost of developing the institutional structure for individuals to collaborate for common benefit. The result was dramatic local economic development and a significant increase in regional exchange between the Kingdoms of Navarra, Aragón and Castilla in Spain and Béarn in France.

The Fuero de Jaca (Aragón) and the “Fuero” de Estella (Navarra) were direct royal agreements with “*personas libres, francas e ingenuas*” (SP)—freemen able to hold property free and clear who worked the land with their own hands (Orella Unzué, 2017; Pavón Benito, 2018). The king would personally sign a fuero with representatives of a community of interest bypassing local elites, and personally promised protection for pilgrims, travelers and merchants who agreed to use the routes the king specified for crossing the Pyrenees including in the western Pyrenees the passes of Larrau, Somport and Ibañeta. Individuals who agreed to these terms were exempted from all taxes and tribute and given the authority to form councils to decide local affairs; the king in turn would sponsor construction of bridges, lodges, and hospitals using the *paria* taxes. The concessions and infrastructure in turn attracted representatives from diverse professions and guilds including money changers, master builders, merchants, and hoteliers accelerating the establishment of churches, monasteries, hospitals and way stations.

Two examples clarify the scale and speed of the social, economic, and political transformation in the western Pyrenees from overcoming conflicts of interest and the commitment to enforce rules supporting collective action. The Order of Cannons Regular of Prémontré formed in 1120 CE put in place at least 34 establishments in southern France including the Basque and Gascogne regions in the western Pyrenees between the 12th–13th centuries CE (Abadie, 2019). The kingdom of Béarn (France) adjacent to Soule and the kingdom of Aragón became close allies c. 1100 CE. To facilitate and protect pilgrims, traders and troops following the old Roman road from Lescar (France) to Zaragoza (Spain) crossing the Pyrenees by the Pass of Somport, the partners established the order of Sainte-Christine du Somport. By the early 13th century, the order included over 20 religious establishments linked to agropastoral domains distributed across the Ossau Valley and the eastern portion of the Soule Valley in France, and the adjoining valleys of Salazar, Roncal, Ansó and Echo in Spain (Lassègues, 2019).

There is a tendency to view monarchs through Hobbe's parable of man in a state of nature who seeks his own good yet ends up fighting with other men only avoiding ruin by the coercive, outside force of Leviathan. The primordial fueros of King Sancho Ramirez and King Alfonso VI are an example of the benign model of select benefits for the provision of public goods between advantaged and disadvantaged social groups (Van Zomeren and Iyer, 2009; Jagers et al., 2020). Opposing the categories of mobile and settled has obscured our grasp of what settling down means to individuals with agency capable of autonomous decision-making. In the same vein, we still lack an evidence-based understanding of the temporal causes of collective action involving a wise and advantaged king contracting with persecuted and disadvantaged individuals to the mutual benefit of both (Thomas et al., 2020).

5 Conclusion

Collective pastoral management regimes in France have continuously challenged the notion of the state as the necessary entity capable of managing the selfish and unruly behavior of individuals. We cannot always predict, however, the solution that herders will arrive at to collaborate with each other. In the Massif Central a sub-component of herders in a commune holds non-transferable title and exclusive use-rights to a section of a single land parcel which exceeds 100 ha in area (Couturier, 2000). By comparison, collective lands in the Alps, the Jura and the Vosges tend to be held by all herders of a single commune interspersed with a legacy feudal form of collective property (i.e., *alpages*, FR, Duparc, 1964). In the eastern Pyrenees herders in a single commune collectively use state lands (i.e., *propriété domaniale*, FR) that originate from 17th century land reforms (Bordessoule, 2007). In the central and western Pyrenees of France and Spain herders from a community of villages or a valley republic use and manage pastoral resources through the Cayolar system first materialized in the Coutume of 1521 CE yet first recorded as a structural institution c. 1000 CE.

Traditional common property systems are complex and their persistence is contingent on interactions over time between broad-scale drivers, local resources, institutions and the agency of individuals (Berkes, 2006; Rammel et al., 2007). Their success or

failure at any given moment is an emergent property of social dynamics between individuals. The representation of traditional common property regimes as cultural archetypes—static and timeless—provides little more insight on the dynamics of resource use and governance than Hardin's or Hobbe's parables. The refined chronologies we provide on the use of Cayolar structures combined with the bottom-up details about social alliances that in turn materialize on the landscape as pastoral inholdings serve to reveal herder's lived experiences in Soule along with the institutions that govern their daily existence. It also gives back to the people their history placing them into the time continuum from their past to their potential future (Birch et al., 2022).

Olson (1965) expressed the problem of collective action as one of balancing the contradictory forces of selfishness and cooperation among individuals united through the self-reflected cohesive force of an institution with the capacity to mobilize shared resources. In France, traditional mountain pastoralism effectively ended in 1960 CE although dispersed remnants can still be encountered in places around the country such as the Soule Valley (Bordessoule, 2007). While pastoralism is now a vestigial practice, examining the Cayolar organization from its antedecents through the early 19th century in the Soule Valley provides critical insights into how herders realize the mutual benefits of cooperation while suppressing individual self-interest with guile (Hecter and Brustein, 1980; Lichbach, 1996; Blanton and Fargher, 2008).

The vulnerability of agropastoralism across European mountain landscapes has led to serious efforts to preserve and reinvigorate the practice (Plieninger and Bieling, 2013). Pastoralism is a millennial practice (Agnoletti, 2007) yet there is still a tendency to abstract communities from history and ignore the situational variables leading local communities to develop solutions by trial-and-error to achieve success over time (Ostrom, 1990). Herding is neither the expression of a rational egoist or an invariant cultural norm. Even though getting things done among the members of our species is always social (Kowalewski and Birch, 2020), individuals still retain free will and use it to make decisions about whether to participate in collective activities or not. By recognizing a herder's agency to choose between opportunities, we acknowledge the creativity of humans to solve situational problems and move past belief toward empirically grounded understanding of human social alliances and institutions in the past as well as the present.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

TG: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing. MC: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration,

Resources, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing.

Pascal Palu and members of the Laboratoire ITEM, Université de Pau et du Pays de l'Adour.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. Partial support for the research has been provided by: the National Geographic Society (9573-14), a STAR Fellowship Assistance Agreement (FP917243), the Coweeta Long Term Ecological Research program funded by the National Science Foundation (DEB-0823293), a Partner University Fund award to the University of Georgia and the Université de Pau, and the Chaire d'Attractivité IdEx Program at the Université de Toulouse (UMR 5608).

Acknowledgments

We gratefully acknowledge officials and residents of the commune of Larrau, France. Logistical support was provided by

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Abadie, S. (2019). "La circulation des chanoines prémontrés à travers les Pyrénées (xii^e-xv^e siècle)," in *Monastères et Couvents de Montagne : Circulation, Réseaux, Influences au Moyen Âge*, ed. D. le Blévec (Paris: Éditions du Comité des Travaux Historiques et Scientifiques), 4887. doi: 10.4000/books.cths.4887
- Agnoletti, M. (2007). The degradation of traditional landscape in a mountain area of Tuscany during the 19th and 20th centuries: Implications for biodiversity and sustainable management. *For. Ecol. Manag.* 249, 5–17. doi: 10.1016/j.foreco.2007.05.032
- Anonymous (1860). *Ravennatis Anonymi Cosmographia et Gvidonis Geographica*. Berolini: Aedibvs Friderici Nicolai.
- Arnold, E. R., and Greenfield, H. J. (2006). *The Origins of Transhumant Pastoralism in Temperate Southeastern Europe: A Zooarchaeological Perspective from the Central Balkans*. Oxford: Archaeopress. doi: 10.30861/9781841719702
- Arrizabalaga, M.-P. (1997). The stem family in the French Basque country: sare in the nineteenth century. *J. Fam Hist.* 22, 50–69. doi: 10.1177/036319909702200103
- Arrizabalaga, M.-P. (2005). Succession strategies in the Pyrenees in the 19th century: the Basque case. *Hist. Fam.* 10, 271–292. doi: 10.1016/j.hisfam.2005.03.002
- Barandiaran, J.M.d., Manterola, A. (2000). *Atlas Etnográfico de Vasconia: Ganadería y Pastoreo en Vasconia*. Bilbao: Etniker Euskalerrria.
- Berkes, F. (2006). From community-based resource management to complex systems: the scale issue and marine commons. *Ecol. Soc.* 11:45. doi: 10.5751/ES-01431-110145
- Birch, J., Hunt, T. W., Lesage, L., Richard, J.-F., Sioui, L. A., Thompson, V. D., et al. (2022). The role of radiocarbon dating in advancing Indigenous-led archaeological research agendas. *Humanit. Soc. Sci. Commun.* 228, 1–6. doi: 10.1057/s41599-022-01249-7
- Blanton, R., and Fargher, L. (2008). *Collective Action in the Formation of Pre-modern States*. New York, NY: Springer. doi: 10.1007/978-0-387-73877-2
- Bloch, M. (1930a). La lutte pour l'individualisme agraire dans la France du XVIII^e siècle: première partie: l'œuvre des pouvoirs d'ancien régime. *Ann. Hist. Écon. Social.* 2, 329–383. doi: 10.3406/ahess.1930.1227
- Bloch, M. (1930b). La lutte pour l'individualisme agraire dans la France du XVIII^e siècle: deuxième partie. Conflits et résultats. *Ann. Hist. Écon. Social.* 2, 511–543. doi: 10.3406/ahess.1930.1264
- Bordessoule, É. (2007). "Appropriation et gestion collective des pâturages d'altitude en France: Crese et adaptation des formules traditionnelles," in *Les Espaces Collectifs dans les Campagnes: XI^e-XXI^e Siècle*, eds P. Charbonnier, P. Couturier, A. Follain, and P. Fournier (Clermont-Ferrand, FR: Presses Universitaires Blaise-Pascal), 399–418.
- Borgatti, S. P., Everett, M. G., and Freeman, L. C. (2002). *UCINET for Windows: Software for Social Network Analysis*. Harvard, MA: Analytic Technologies.
- Brocas, D., and Legaz, A. (2005). "La montagne Basque: sources et ressources. Les pâturages et les bois dans les Pyrénées occidentales (XI-XIX siècles)," in: *Les Ressources Naturelles des Pyrénées du Moyen Âge à l'époque Moderne: Exploitation, Gestion, Appropriation*, eds A. Catafau (Perpignan: Presses Universitaires de Perpignan), 49–69.
- Bronk Ramsey, C. (1995). Radiocarbon calibration and analysis of stratigraphy: the OxCal program. *Radiocarbon* 37, 425–430. doi: 10.1017/S0033822200030903
- Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. *Radiocarbon* 51, 337–360. doi: 10.1017/S0033822200033865
- Bronk Ramsey, C. (2017). Methods for summarizing radiocarbon datasets. *Radiocarbon* 59, 1809–1833. doi: 10.1017/RDC.2017.108
- Cavaillès, H. (1931a). *La Transhumance Pyrénéenne et la Circulation des Troupeaux dans les Plaines de Gascogne*. Paris: Librairie Armand Colin.
- Cavaillès, H. (1931b). *La vie Pastorale et Agricole Dans les Pyrénées des Gaves, de l'Aour et des Nestes*. Paris: Librairie Armand Colin.
- Champagne, A., Contamine, T., Coughlan, M., Gragson, T., and Haley, B. S. Le Couédic, M.L. (2014). *Rapport de Prospection et Sondages Larrau, Pyrénées-Atlantiques, ITEM (EA 3002)*. Pau: Université de Pau et des Pays de l'Adour, 129.
- Cierbide, R. (1994). *Le Censier Gothique de Soule*. St. Etienne de Baïgorry: Editions Izpegi.
- Clérgeot, P. (2007). *Cent Millions de Parcelles en France: 1807 - Un Cadastre Pour l'Empire*. Paris: Editions Publi-Topex.
- Coase, R. H. (1937). The nature of the firm. *Economica* 4, 386–405. doi: 10.1111/j.1468-0335.1937.tb00002.x
- Coughlan, M. R. (2013). Errakina: pastoral fire use and landscape memory in the Basque region of the French western Pyrenees. *J. Ethnobiol.* 33, 86–104. doi: 10.2993/0278-0771-33.1.86
- Coughlan, M. R. (2014). Farmers, flames, and forests: historical ecology of pastoral fire use and landscape change in the French Western Pyrenees. *For. Ecol. Manag.* 312, 55–66. doi: 10.1016/j.foreco.2013.10.021
- Coughlan, M. R. (2015). Traditional fire-use, landscape transition, and the legacies of social theory past. *Ambio* 44, 705–717. doi: 10.1007/s13280-015-0643-y
- Coughlan, M. R., and Gragson, T. L. (2016). An event history analysis of parcel extensification and household abandonment in Pays Basque, French Pyrenees, 1830–1958 AD. *Hum. Ecol.* 44, 65–80. doi: 10.1007/s10745-016-9808-y
- Coughlan, M. R., Gragson, T. L., and Leigh, D. S. (2022). Landscape conservation and the ancient technique of pastoral fire in the western Pyrenees. *PAGES* 30, 38–39. doi: 10.22498/pages.30.1.38
- Coughlan, M. R., Leigh, D. S., Gragson, T. L., and Le Couédic, M. (2023). "Holocene anthropization of mid-elevation landscapes around Pic d'Orhy, Western Pyrenees,"

in *Archaeology of Mountain Landscapes: Interdisciplinary Research Strategies of Agro-Pastoralism in Upland Regions*, ed A. Garca-Molsosa (Albany, NY: State University of New York), 277–301.

Couturier, P. (2000). *Sections et Biens Sectionaux dans le Massif Central*. Clermont-Ferrand: Presses universitaires Blaise Pascal.

Cronk, L., and Leech, B. L. (2013). *Meeting at Grant Centrla: Understanding the Social and Evolutionary Roots of Cooperation*. Princeton, NJ: Princeton University Press. doi: 10.1515/9781400845484

Cursent, B. (1994). “Église et habitat dans les villages gascons: quelques aspects topographiques (XIe-XVe s.),” in *L'environnement des Églises et la Topographie Religieuse des Campagnes Médiévales*, eds M. Fixot, and E. Zadora-Rio (Paris: Éditions de la Maison des Sciences de l'homme), 223–238. doi: 10.4000/books.editionsmsmh.40213

Cursent, B. (1998). *Des Maisons et des Hommes: La Gascogne Médiévale (XIe - XVe Siècle)*. Toulouse: Presses Universitaires du Mirail. doi: 10.4000/books.pumi.18031

Dalla-Rosa, G. (1984). La zone de montagne dans les Pyrénées Atlantiques : une délimitation controversée. *Rev. Géogr. Alp.* 72, 347–361. doi: 10.3406/rga.1984.2576

De Reu, J., Bourgeois, J., De Smedt, P., Zwertvaegher, A., Antrop, M., and Bats, P. (2011). Measuring the relative topographic position of archaeological sites in the landscape, a case study on the Bronze Age barrows in northwest Belgium. *J. Archaeol. Sci.* 38, 3435–3446. doi: 10.1016/j.jas.2011.08.005

Duparc, P. (1964). Les tenures en hébergement et en abergement. *Bibl. Ec. Chartes* 122, 5–88. doi: 10.3406/bec.1964.449668

Etchegoyhen, P. (2012). *Mémoires Souletines - Tome 2, Bergers et Cayolers*. Donostia: Elkar Argitaletxea.

Euskaltzaindia (2022). *Basque Onomastics Database (EODA)*. Bilbao: Royal Academy of the Basque Language.

Falque-Vert, H. (1997). *Les Hommes et la Montagne en Dauphiné au XIII Siècle*. Grenoble: Presses Universitaires de Grenoble.

Feeny, D., Berkes, F., McCay, B. J., and Acheson, J. M. (1990). The tragedy of the commons: twenty-two years later. *Hum. Ecol.* 18, 1–19. doi: 10.1007/BF00889070

Feinman, G. M., and Neitzel, J. E. (2020). Excising culture history from contemporary archaeology. *J. Anthropol. Archaeol.* 60:101230. doi: 10.1016/j.jaa.2020.101230

Feinman, G. M., and Neitzel, J. E. (2023). The social dynamics of settling down. *J. Anthropol. Archaeol.* 69:101468. doi: 10.1016/j.jaa.2022.101468

Fernández Mier, M., and Quirós Castillo, J. A. (2015). El aprovechamiento de los espacios comunales en el noroeste de la Península Ibérica entre el período romano y el medieval. *Cap. Cult.* 12, 689–717. doi: 10.13138/2039-2362/1196

Fredegar, V. P. (1981). *The Fourth Book of the Chronicle of Fredegar*. Westport: Greenwood Press.

Galop, D., Rius, D., Cugny, C., and Mazier, F. (2013). “A history of long-term human–environment interactions in the french pyrenees inferred from the pollen data,” in *Continuity and Change in Cultural Adaptation to Mountain Environments*, ed L. L. Zozny (New York, NY: Springer), 19–30. doi: 10.1007/978-1-4614-5702-2_3

Goodreau, S. M. (2007). Advances in exponential random graph (p*) models applied to a large social network. *Soc. Netw.* 29, 231–248. doi: 10.1016/j.socnet.2006.08.001

Goodreau, S. M., Kitts, J. A., and Morris, M. (2009). Birds of a feather, or friend of a friend? Using exponential random graph models to investigate adolescent social networks. *Demography* 46, 103–126. doi: 10.1353/dem.0.0045

Goyheneche, E. (1973). *Instituciones Administrativas dels Pais Vasco Frances en la Edad Media*. Madrid: Instituto Nacional de Estudios Jurídicos.

Gragson, T. L., Coughlan, M. R., and Leigh, D. S. (2020). Contingency and agency in the mountain landscapes of the western Pyrenees: a place-based approach to the long anthropocene. *Sustianability* 12:3882. doi: 10.3390/su12093882

Gragson, T. L., Coughlan, M. R., and Leigh, D. S. (2021). “Response diversity and the evolution of pastoral landscapes in the western Pyrenees,” in *Transhumance*, eds M. Bowden, and P. Herring (Oxford: Archaeopress Publishing Ltd), 63–75.

Gragson, T. L., and Thompson, V. D. (2022). Legacy radiocarbon dates and the archaeological chronology of the western Pyrenees. *J. Archaeol. Sci.* 43:103483. doi: 10.1016/j.jasrep.2022.103483

Granovetter, M. S. (1978). Threshold models of collective behavior. *Am. J. Sociol.* 83, 1420–1443. doi: 10.1086/226707

Grosclaude, M. (1993). *La Coutume de la Soule*. Pau: Editions Izpegi.

Hamilton, W. D., and Krus, A. M. (2018). The myths and realities of Bayesian chronological modeling revealed. *Am. Antiq.* 83, 187–203. doi: 10.1017/aaq.2017.57

Hardin, G. (1968). The tragedy of the commons. *Science* 162, 1243–1248. doi: 10.1126/science.162.3859.1243

Heckathorn, D. D. (1996). The dynamics and dilemmas of collective action. *Am. Sociol. Rev.* 61, 250–277. doi: 10.2307/2096334

Hecter, M., and Brustein, W. (1980). Regional modes of production and patterns of state formation in western europe. *Am. Sociol. Rev.* 85, 1061–1094. doi: 10.1086/227125

Hodgson, G. M. (2001). *How Economics Forgot History: The Problem of Historical Specificity in Social Science*. London: Routledge.

Jagers, S. C., Harring, N., Lofgren, A., Sjøstedt, M., Alpizar, F., Brulde, B., et al. (2020). On the preconditions for large-scale collective action. *Ambio* 49, 1282–1296. doi: 10.1007/s13280-019-01284-w

Kahneman, D. (2011). *Thinking, Fast and Slow*. New York, NY: Farrar, Straus and Giroux.

Kenny, D. A., Kashy, D. A., and Cook, W. L. (2006). *Dyadic Data Analysis*. New York, NY: The Guilford Press.

Kitts, J. A. (2006). Collective action, rival incentives, and the emergence of antisocial norms. *Am. Sociol. Rev.* 71, 235–259. doi: 10.1177/000312240607100204

Kowalewski, S. A., and Birch, J. (2020). “How do people get big things done?” in *The Evolution of Social Institutions: Interdisciplinary Perspectives*, ed. Bondarenko (New York, NY: Springer), 29–50. doi: 10.1007/978-3-030-51437-2_2

Krivitsky, P. N., Handcock, M. S., Hunter, D. R., Butts, C. T., Klumb, C., Goodreau, S. M., et al. (2003–2022). *statnet: Software Tools for the Statistical Modeling of Network Data*. Statnet Development Team. Available online at: <https://statnet.org>

Krivitsky, P. N., Hunter, D. R., Morris, M., and Klumb, C. (2023). ergm4: new features for analyzing exponential-family random graph models. *J. Stat. Softw.* 105, 1–44. doi: 10.18637/jss.v105.i06

Lafourcade, M. (2006). Le statut juridique des groupes sociaux en Iparralde sous l'Ancien Régime. *Iura Vasconiae* 3, 159–191.

Lafourcade, M. (2010a). La démocratie basque. *Boletín JADO* 8, 171–209.

Lafourcade, M. (2010b). L'autonomie administrative du Pays Basque de France sous l'Ancien Régime. *Boletín JADO* 8, 111–139.

Lafourcade, M. T. (2003). Les assemblées provinciales du Pays Basque Français sous l'Ancien Régime. *Rev. Int. Estud. Vascos* 48, 589–619. doi: 10.4000/lapurdum.1580

Larrea, J. J. (1998). *La Navarre du IVe au XIIe Siècle: Peuplement et Societe*. Brussels: De Boeck Universite.

Lassègues, J. C. (2019). “Le réseau canonial de Sainte-Christine du Somport : mécanismes de son développement sur le versant nord,” in *Monastères et Couvents de Montagne : Circulation, Réseaux, Influences au Moyen Âge*, ed M. le Blévec (Paris: Éditions du Comité des Travaux Historiques et Scientifiques), 4914. doi: 10.4000/books.cths.4914

Lefebvre, H. (1963). *La Vallée de Campan: Étude de Sociologie Rurale*. Paris: Presses Universitaires de France.

Lefebvre, T. (1928). La transhumance dans les Basses-Pyrénées. *Ann. Géogr.* 37, 35–60. doi: 10.3406/geo.1928.9198

Lefebvre, T. (1933). *Les Modes de vie Dans les Pyrénées Atlantiques Orientales*. Paris: Librairie Armand Colin.

Leigh, D. S., Gragson, T. L., and Coughlan, M. R. (2015). Chronology and pedogenic effects of mid- to late-Holocene conversion of forests to pastures in the French western Pyrenees. *Z. Geomorphol.* 59, 225–245. doi: 10.1127/zfg_suppl/2015/S-59212

Leigh, D. S., Gragson, T. L., and Coughlan, M. R. (2016). Colluvial legacies of millennial landscape change on individual hillsides, place-based investigation in the western Pyrenees mountains. *Quat. Int.* 402, 61–71. doi: 10.1016/j.quaint.2015.08.031

Lichbach, M. I. (1996). *The Cooperator's Dilemma*. Ann Arbor, MI: University of Michigan Press. doi: 10.3998/mpub.13808

Manning, S., and Birch, J. (2022). A centennial ambiguity: the challenge of resolving the date of the Jean-Baptiste Lainé (Mangle), Ontario, Site - Around AD 1500 or AD 1600? - the case for wood-charcoal as a terminus post quem. *Radiocarbon* 64, 279–308. doi: 10.1017/RDC.2022.23

Martín Duque, Á. J. (2002a). La comunidad del Valle de Salazar: orígenes y evolución histórica. *Príncipe Viana* 63, 635–666. Available online at: <https://revistas.navarra.es/index.php/PV/article/view/2408>

Martín Duque, Á. J. (2002b). Algunas observaciones sobre el carácter originario de la monarquía pamplonesa. *Príncipe Viana* 227, 835–839. Available online at: <https://binadi.navarra.es/registro/00012842>

Martínez González, A. J. (2012). “El fuero de Estella: Instrumento de atracción en las peregrinaciones europeas,” in *IX Congreso Internacional de Asociaciones Jacobeas: El Mediterráneo en el Origen*, ed A. Sánchez Ribes (Valencia: Asociación Amigos del Camino de Santiago de la Comunidad Valenciana), 75–92.

McCabe, J. T. (1990). Turkana pastoralism: a case against the tragedy of the commons. *Hum. Ecol.* 18, 81–103. doi: 10.1007/BF00889073

McCay, B. J., and Acheson, J. M. (1987). *The Question of the Commons: The Culture and Ecology of Communal Resources*. Tucson, AZ: University of Arizona Press.

Motte, C., and Vouloir, M.-C. (2017). *Des Villages de Cassini aux Communes D'aujourd'hui*. Paris: Ecole des Hautes Études en Sciences Sociales.

Netting, R. M. (1972). Of men and meadows: atriages of Alpine land use. *Anthropol. Q.* 45, 132–144. doi: 10.2307/3316527

- Netting, R. M. (1976). What alpine peasants have in common: observations on communal tenures in a Swiss village. *Hum. Ecol.* 4, 135–146. doi: 10.1007/BF01531217
- Netting, R. M. (1981). *Balancing on an Alp*. Cambridge: Cambridge University Press.
- North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511808678
- Noussy Saint-Saëns, M. (1955). *Le pays de Soule: Essai sur la Coutume Basque*. Bordeaux: Clèdes and Fils.
- Olson, M. (1965). *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge: Harvard University Press.
- Orellana Unzué, J. L. (2017). Sistema jurídico pirenaico versus el mesetario Español. *Lurralde* 40, 273–313. doi: 10.52748/lurralde.2017.40.51
- Orpustan, J.-B. (2010). *Nouvelle Toponymie Basque: Noms des Pays, Vallées, Communes et Hameaux Historiques de Labourd, Basse-Navarre et Soule*. Bordeaux: PU BORDEAUX, 148.
- Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511807763
- Ott, S. (1993). *The Circle of Mountains: A Basque Shepherding Community*. Reno: University of Nevada Press.
- Palu, P. (1992). Rapports entre organisation sociale et écosystème dans la société pastorale souleline. *Soc. Contemp.* 11, 239–264. doi: 10.3406/socco.1992.1090
- Pavón Benito, J. (2018). Poblamiento medieval en Navarra. *Cuad. Arqueol.* 3, 271–300. doi: 10.15581/012.3.27823
- Plieninger, T., and Bieling, C. (2013). Resilience-based perspectives to guiding high-nature-value farmland through socioeconomic change. *Ecol. Soc.* 18, 20. doi: 10.5751/ES-05877-180420
- Poumaredé, J. (1984). Les syndicats de vallée dans les Pyrénées Françaises. *Rec. Soc. Jean. Bodin.* 43, 385–409.
- Quirós Castillo, J. A. (2020). Archaeology of early medieval peasantry in the Basque country: landscapes, economic trends and societal change in Álava. *Hist. Agrar.* 82, 209–243. doi: 10.26882/histagrar.082e04q
- Quirós Castillo, J. A., Narbarte, J., and Iriarte, E. (2023). What is a village? Agroscaes, collective action and medieval villages in northern Iberia. *Antiquity* 97, 1279–1295. doi: 10.15184/aqy.2023.125
- R Core Team (2013). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.
- Rammel, C., Stagl, S., and Wilfing, H. (2007). Managing complex adaptive systems — a co-evolutionary perspective on natural resource management. *Ecol. Econ.* 63, 9–21. doi: 10.1016/j.ecolecon.2006.12.014
- Reimer, P., Austin, W., Bard, E., Bayliss, A., Blackwell, P., Bronk Ramsey, C., et al. (2020). The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon* 62, 725–757. doi: 10.1017/RDC.2020.41
- Rhoades, R. E., and Thompson, S. I. (1975). Adaptive strategies in alpine environments: beyond ecological particularism. *Am. Ethnol.* 2, 535–551. doi: 10.1525/ae.1975.2.3.02a00110
- Richer, M. (1998). Le Cayolar en soule. *Azpilcueta* 13, 123–130.
- Rius, D., Vannière, B., and Galop, D. (2009). Fire frequency and landscape management in the northwestern Pyrenean piedmont, France, since the early Neolithic (8000 cal. BP). *Holocene* 19, 847–859. doi: 10.1177/0959683609105299
- Robins, G., Elliott, P., and Pattison, P. (2001). Network models for social selection processes. *Soc. Netw.* 23, 1–30. doi: 10.1016/S0378-8733(01)0029-6
- Robins, G., Pattison, P., Kalish, Y., and Lusher, D. (2007). An introduction to exponential random graph (p*) models for social networks. *Soc. Netw.* 29, 173–191. doi: 10.1016/j.socnet.2006.08.002
- RStudio Team (2015). *RStudio: Integrated Development for R*. Boston, MA: RStudio, Inc.
- Smith, E. A., and Wishnie, M. (2000). Conservation and subsistence in small-scale societies. *Ann. Rev. Anthropol.* 29, 493–524. doi: 10.1146/annurev.anthro.29.1.493
- Snijders, T. A. B., van de Bunt, G. G., and Steglich, C. E. G. (2010). Introduction to stochastic actor-based models for network dynamics. *Soc. Netw.* 32, 44–60. doi: 10.1016/j.socnet.2009.02.004
- Takács, K., Janky, B., and Flache, A. (2008). Collective action and network change. *Soc. Netw.* 30, 177–189. doi: 10.1016/j.socnet.2008.02.003
- Testart, A. (2003). Propriété et non-propriété de la terre: L'illusion de la propriété collective archaïque (1re partie). *Etud. Rurales* 165–166, 209–242. doi: 10.4000/etudesrurales.8009
- Thaler, R. H. (2015). *Misbehaving: The Making of Behavioral Economics*. New York, NY: W. W. Norton and Company.
- Thomas, E. F., Zubielevitch, E., Sibley, C. G., and Osborne, D. (2020). Testing the social identity model of collective action longitudinally and across structurally disadvantaged and advantaged groups. *Pers. Soc. Psychol. Bull.* 46, 823–838. doi: 10.1177/0146167219879111
- Thompson, V. D., Marquardt, W. H., Walker, K. J., Thompson, A. D. R., and Newsom, L. A. (2018). Collective action, state building, and the rise of the Calusa, southwest Florida, USA. *J. Anthropol. Archaeol.* 51, 28–44. doi: 10.1016/j.jaa.2018.05.003
- Unzu Urmeneta, M. (2021). Excavacions arqueològiques en Ibañeta: resultados e hipòtesis. *Pregón* 59, 17–21.
- Urrutibéthy, C. (1983). *Casas Hospitalisa. Diez Siglos de Historia en Ultrapuertos*. Pamplona: Institution Príncipe de Viana.
- Van Zomeren, M., and Iyer, A. (2009). Introduction to the social and psychological dynamics of collective action. *J. Soc. Issues* 65, 645–660. doi: 10.1111/j.1540-4560.2009.01618.x
- van Zomeren, M., Postmes, T., and Spears, R. (2008). Toward an integrative social identity model of collective action: a quantitative research synthesis of three socio-psychological perspectives. *Psychol. Bull.* 134, 504–535. doi: 10.1037/0033-2909.134.4.504
- Vivier, N. (1998). *Propriété Collective et Identité Communale. Les Biens Communaux en France 1750-1914*. Paris: Publications de la Sorbonne.
- Wang, P., Robins, G., Pattison, P., and Lazega, E. (2013). Exponential random graph models for multilevel networks. *Soc. Netw.* 35, 96–115. doi: 10.1016/j.socnet.2013.01.004
- Wasserman, S., and Pattison, P. (1996). Logit models and logistic regressions for social networks: I. An introduction to Markov Graphs and p*. *Psychometrika* 61, 401–425. doi: 10.1007/BF02294547
- Whittle, A. (2018). *The Times of their Lives: Hunting History in the Archaeology of Neolithic Europe*. Oxford: Oxbow Books. doi: 10.2307/j.ctvh1dm57



OPEN ACCESS

EDITED BY

Victor D. Thompson,
University of Georgia, United States

REVIEWED BY

Neill Wallis,
University of Florida, United States
Jacob Holland-Lulewicz,
The Pennsylvania State University (PSU),
United States

*CORRESPONDENCE

G. Logan Miller
✉ glmill1@illinoisstate.edu

RECEIVED 13 December 2023

ACCEPTED 01 February 2024

PUBLISHED 21 February 2024

CITATION

Miller GL (2024) Settling down with
anthropomorphic clay figurines in eastern
North America.
Front. Hum. Dyn. 6:1355421.
doi: 10.3389/fhumd.2024.1355421

COPYRIGHT

© 2024 Miller. This is an open-access article
distributed under the terms of the [Creative
Commons Attribution License \(CC BY\)](#). The
use, distribution or reproduction in other
forums is permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication in
this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted
which does not comply with these terms.

Settling down with anthropomorphic clay figurines in eastern North America

G. Logan Miller*

Department of Sociology and Anthropology, Illinois State University, Normal, IL, United States

Indigenous peoples have occupied eastern North America for over 10,000 years; yet the earliest anthropomorphic figurines were only manufactured in the past several thousand years. This emergence of human figurine traditions in eastern North America is correlated with increased settlement permanence, and community size related to key demographic thresholds. In this study, I present an overview of two previously unreported figurine assemblages from the Middle Woodland period in Illinois and use these assemblages as a jumping-off point to examine the emergence of early human figurines in eastern North America. To illustrate the importance of the correlation between anthropomorphic figurines and settling down, I focus on what figurines do that encouraged the emergence of widespread traditions of figurine manufacture and use as the size of affiliative communities increased. This study involves examining early figurines and their broader context through the lens of a model of the socioeconomic dynamics of settling down in conjunction with an examination of the materiality of miniature 3-D anthropomorphic figurines. Key to this latter perspective is understanding not what figurines represent but what they do.

KEYWORDS

figurines, middle woodland, Hopewell, socioeconomic dynamics, materiality

Introduction

This study focuses on early anthropomorphic clay figurines in eastern North America and the timing of their appearance in relation to periods of important changes in settlement, community, and ceremonialism. I interrogate the nature of these correlations by asking what figurines do that encouraged the emergence of widespread traditions of figurine manufacture and use as people were settling down? Answering this question involves examining early figurines and their broader context through a model of the socioeconomic dynamics of settling down ([Feinman and Neitzel, 2023](#)) in conjunction with the materiality of miniature 3-D anthropomorphic figurines (i.e., [Bailey, 2005](#)). To build this argument, I present an overview of two previously unreported figurine assemblages from the Middle Woodland period in Illinois and use these as a jumping-off point to discuss the emergence of early human figurines in eastern North America. Overall, this example illustrates general patterns and important variations associated with alternative pathways to settling down and making anthropomorphic figurines.

Early anthropomorphic figurines in eastern North America

The first widespread anthropomorphic figurine tradition in the region occurs during the Middle Woodland period (*circa* 100 BCE–400 CE).¹ These clay figurines have been recovered from dozens of settlements and mounds across eastern North America from Kansas to North Carolina and from Illinois to Florida (Figure 1). My focus here is on clay figurines as these are the most ubiquitous anthropomorphic objects while acknowledging that these are part of a larger pattern of human representation that emerges in the Middle Woodland.²

¹ The earliest human figurines in eastern North America (the region from the Mississippi River Valley to the Atlantic) have been recovered from Poverty Point (Connolly, 2008, p. 103). The monumental earthen mounds and embankments at Poverty Point were a center for settlement, pilgrimage, and ceremony *circa* 3,700–3,100 years ago (Gibson, 2001; Connolly, 2008). While the mounds of Poverty Point are not the oldest earthen monuments in eastern North America, there is nothing from this period that approaches their size, scale, and concentration. In fact, Mound A at Poverty Point is the second largest ancient earthen construction in North America and would not be surpassed in size until the construction of Monks Mound at Cahokia over 4,000 years later (Ortmann and Kidder, 2013). While the number of inhabitants at Poverty Point likely swelled during large gatherings, there was a sizeable permanent resident population at the site. Most figurines were recovered from the ridges, which are hypothesized to be habitation areas of the site. Despite early claims of uniformity (Ford and Webb, 1956, p. 49–50), the figurines from Poverty Point “exhibit considerable variation with many unique or rare styles and forms including belts, necklaces, folded arms, and clothing” (Connolly, 2008, p. 103). Some of the figurines have pronounced stomachs and what appear to be breasts, leading to the interpretation that these represent pregnant women. However, many other figurines are highly ambiguous when it comes to representing anything other than a general human form (Gibson, 2001, p. 151–153). The Poverty Point example is anomalous in comparison to the Middle Woodland tradition as figurines seem to be restricted to the Poverty Point site and have not been recovered from other Poverty Point Culture sites. The Poverty Point figurine tradition comes to an end with the cessation of occupation at Poverty Point and associated sites around 3,000 years ago (Kidder et al., 2018). Over the next several centuries, there appears to be a widespread population reduction across large swaths of eastern North America coincident with larger climactic changes (Kidder, 2006).

² Other media that include human images are stone figurines and pipes, fossil ivory, copper and mica cutouts, chipped chert lamellar blades, carved human bone, and clay funerary masks (Cook and Farnsworth, 1981; Keller and Carr, 2005, p. 460; Markman, 1988, p. 284; Swartz, 2001a). One further point of clarification involves human representations in Adena contexts such as some stone tablets and the Adena Man pipe. While traditional culture historical schemes placed Adena squarely in the Early Woodland period in an ancestor–descendant relationship with Middle Woodland/Hopewell, radiocarbon dates reveal substantial temporal overlap (Lepper et al., 2014; Henry and Miller, 2020; Henry et al., 2020, 2021). For example, the Adena Mound, from which the Adena Man pipe was recovered, dates to the first century AD concurrent with the construction and use of some of the large geometric Hopewell enclosures in the region (Lepper et al., 2014, Figure 6). Most Adena tablets were recovered from undocumented or undated contexts but the Wright Mound tablet dates

The Middle Woodland period of eastern North America is generally characterized as a time of florescence of burial ceremonialism, monumental earthen construction, and artistry, which is commonly referred to as Hopewell (Seaman, 2004, 2020; Charles and Buikstra, 2006; Abrams, 2009; Wright and Henry, 2013; Miller, 2021; Carr, 2022). Application of the Hopewell label over geographically widespread practices masks extensive diversity (see chapters in Brose, 1979). Concepts such as glocalization (Wright, 2020) and situations such as that described in the study of Henry and Miller (2020) highlight recent attempts to analyze Middle Woodland ceremonialism as variable, multi-scalar dialectic relationships between large scale processes and local developments. It is equally difficult to briefly summarize other aspects of life in this period, but generally Middle Woodland subsistence changes include the increased cultivation of indigenous seed crops to the point of low-level food production in the central interior of eastern North America but not near the coasts (Smith, 1992). Settlement is characterized by population concentration in river valleys perhaps concomitant with stabilization of these ecosystems after centuries of fluctuation (Charles, 2012).

In the central Illinois River valley, small, dispersed settlements and the use of crypt-ramp burial mounds appear by the last century BCE (Struever, 1965, 1968; Ruby et al., 2005). By approximately 50 BCE, settlement expanded south into the largely unoccupied lower Illinois river valley, as evidenced by the bluff-top mound groups that were constructed in a generally north to south chronological trend over several hundred years (Buikstra and Charles, 1999; Ruby et al., 2005; King et al., 2011; Herrmann et al., 2014; Farnsworth and Atwell, 2015, p. 199). In addition to burial ceremonialism, the mound groups were centers of feasting, exchange, and social interaction for communities who periodically gathered at these sites (Struever and Houart, 1972; Buikstra and Charles, 1999; Henry et al., 2021; Weiland et al., 2023). In the Illinois valley, ceremonial gatherings at the mound groups were integral to the formation and maintenance of communities where bluff-top mound groups generally served smaller communities than floodplain mound centers (e.g., Ruby et al., 2005, p. 136). Day-to-day occupation did not occur at mound centers but dispersed habitation sites, aka hamlets, throughout the Illinois and tributary valleys. Individual hamlets generally provided evidence of one to three contemporaneous households (Struever, 1968; Asch et al., 1979; Stafford and Sant, 1985; Ruby et al., 2005). In the intensively studied lower Illinois valley, individual habitations often “cluster in groups of two or three and upward to five, with 0.8 to 1.6 kilometers between hamlets in a cluster and much larger distances among clusters” (Ruby et al., 2005, p. 134).

“New” figurine assemblages

My foray into figurines began with an examination of the figurine assemblage from Loy and Crane, two Middle Woodland settlements

back to approximately 200 AD (Henry and Barrier, 2016, Table 1; Rafferty, 2005, p. 168) and is the sole dated tablet depicting a human form. Thus, in spite of some taxonomic ambiguity, all depictions of the human form date to the Middle Woodland period.

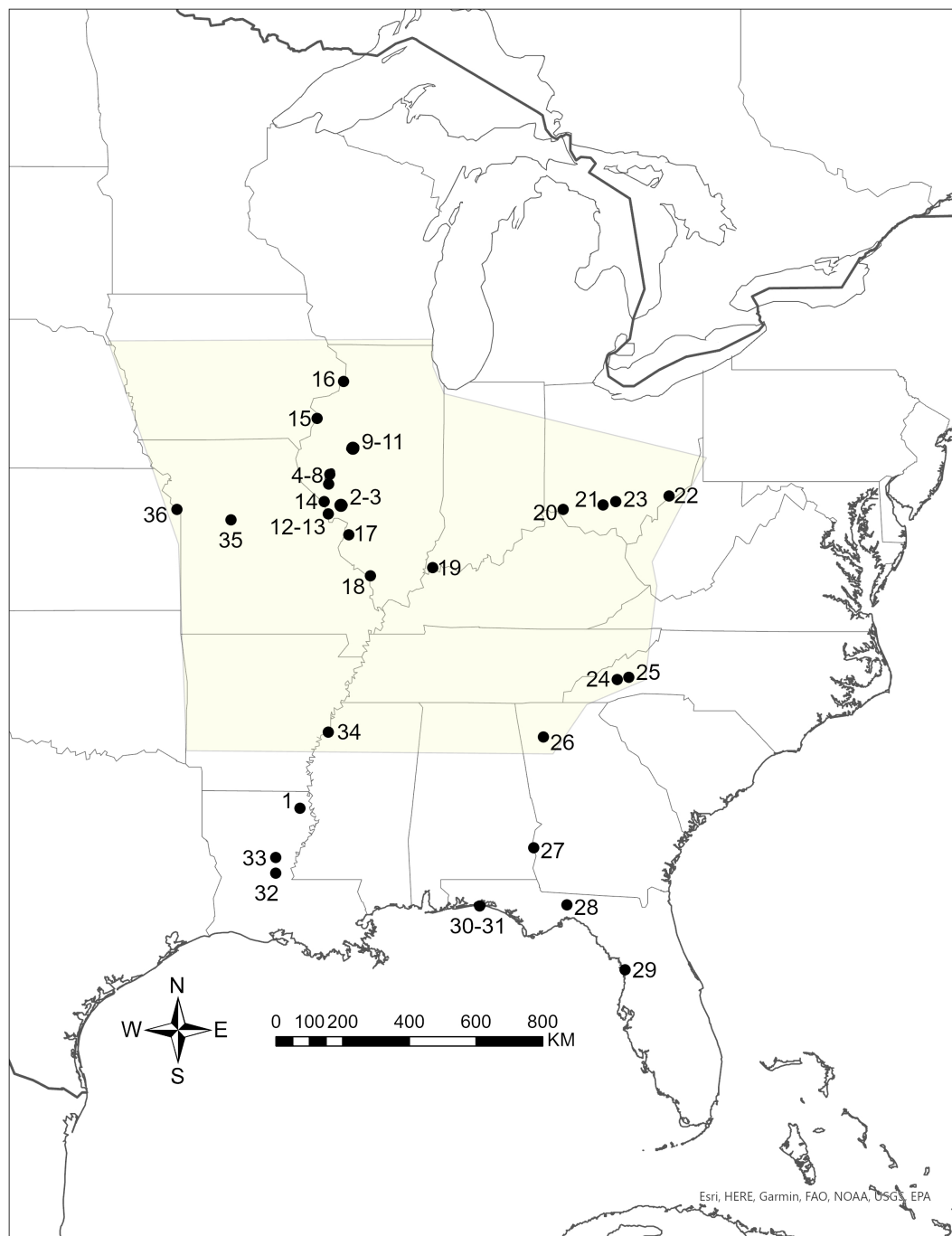


FIGURE 1

Map of sites with figurines mentioned in text. (1) Poverty Point; (2) Loy; (3) Crane; (4) Smiling Dan; (5) Pool; (6) Irving; (7) Baehr; (8) Blue Creek; (9) Clear Lake; (10) Weaver; (11) Whitnah; (12) Snyders; (13) Peisker; (14) Knight/Ansell; (15) Putney Landing; (16) Albany; (17) American Bottom; (18) Twenhafel; (19) Mann; (20) Turner; (21) Seip; (22) Marietta; (23) McGraw; (24) Garden Creek; (25) Biltmore; (26) Leake; (27) Mandeville; (28) Crystal River; (29) Block-Sterns; (30) Buck; (31) Bell; (32) Marksville; (33) Crooks; (34) Dickerson; (35) Mellor; (36) Trowbridge. Shaded area represents the extent of Eastern Agricultural Complex plant cultivation in the Middle Woodland based on Mueller et al. (2020, Figure 1) edited to include portions of North Carolina due to evidence for Middle Woodland cultivars/domesticates in the region (Kimball et al., 2010; Wright, 2020).

in a tributary valley of the lower Illinois River (Asch and Asch, 1985, p. 205–208; Carr, 1982; Miller and Farnsworth, 2023). The figurines from Loy and Crane are not particularly remarkable in terms of detail compared with other reported examples from the Middle Woodland period (e.g., McKern et al., 1945). Nevertheless, they are certainly valuable as additional data. Additionally, their lack of detail

encouraged me to look beyond what they are representations of (*sensu* Bailey, 2005) for inspiration. Thus, I report these figurines here as a jumping-off point on early figurines in eastern North America.

Loy and Crane were investigated via surface collection and excavation, both of random test units and larger excavation blocks, by crews from the Center for American Archeology, under the direction

of Ken Farnsworth, in the early to mid-1970s. The absence of mounds or ancestor burials, the high proportion of Havana as opposed to Hopewell series ceramics, and the preponderance of pits, posts, and habitation debris all indicate that Loy and Crane were the loci of everyday settlements as opposed to mortuary centers or ritual camps (Asch and Asch, 1985, p. 205–208; Carr, 1982; Miller and Farnsworth, 2023). Over two dozen total figurine fragments were recovered, but no complete figurines were present in either assemblage (Figures 2, 3). Figurines were recovered across each site from surface, plowzone, and pit feature contexts. However, only one feature contained more than one figurine fragment, and there is no evidence to suggest that any figurines were deposited in caches or other formal deposits that differed from other materials.

Most figurines have little detail beyond the general shape of a torso, shoulders, nubs for arms, and a relatively featureless lower body, giving rise to the local moniker of “Casper the Ghost” style (Struever and Houart, 1972, p. 73) due to the similarity to the eponymous pop culture character (Figures 2A–D, F, 3B, D, I, J, K, M). One figurine head/face was recovered from each site (Figures 2F, 3C, 4). The head from

Loy was excavated in the plowzone of a test unit. The right side of the face had been eroded away but the left eye and mouth are indicated by impressed slits while the clay was pinched to form a small protuberance of a nose and chin (Figure 4, top). No other detail is present, but the general shape of the head may indicate a longer hair style with hair expanding to the jawline. The head from Crane was recovered from a surface collection square. Similar to the figurine found at Loy, the eyes and mouth are indicated by impressed slits while a small protuberance of a nose was pinched from the clay (Figure 4, bottom). The Crane head is more rounded than the elongated head from Loy. There is no evidence of hair or other features, and the surface is not smoothed or polished.

Aside from the figurine head, only one figurine from Loy contains much detail beyond the Casper the Ghost representation of the general human body. This fragment was recovered from a pit feature that also contained a dog burial (Cantwell, 1980), though it was from a different fill layer. It lacks a head, although no clear break is visible between the shoulders (Figure 2D). It is broken below the chest which contains two projections that could represent breasts. One figurine

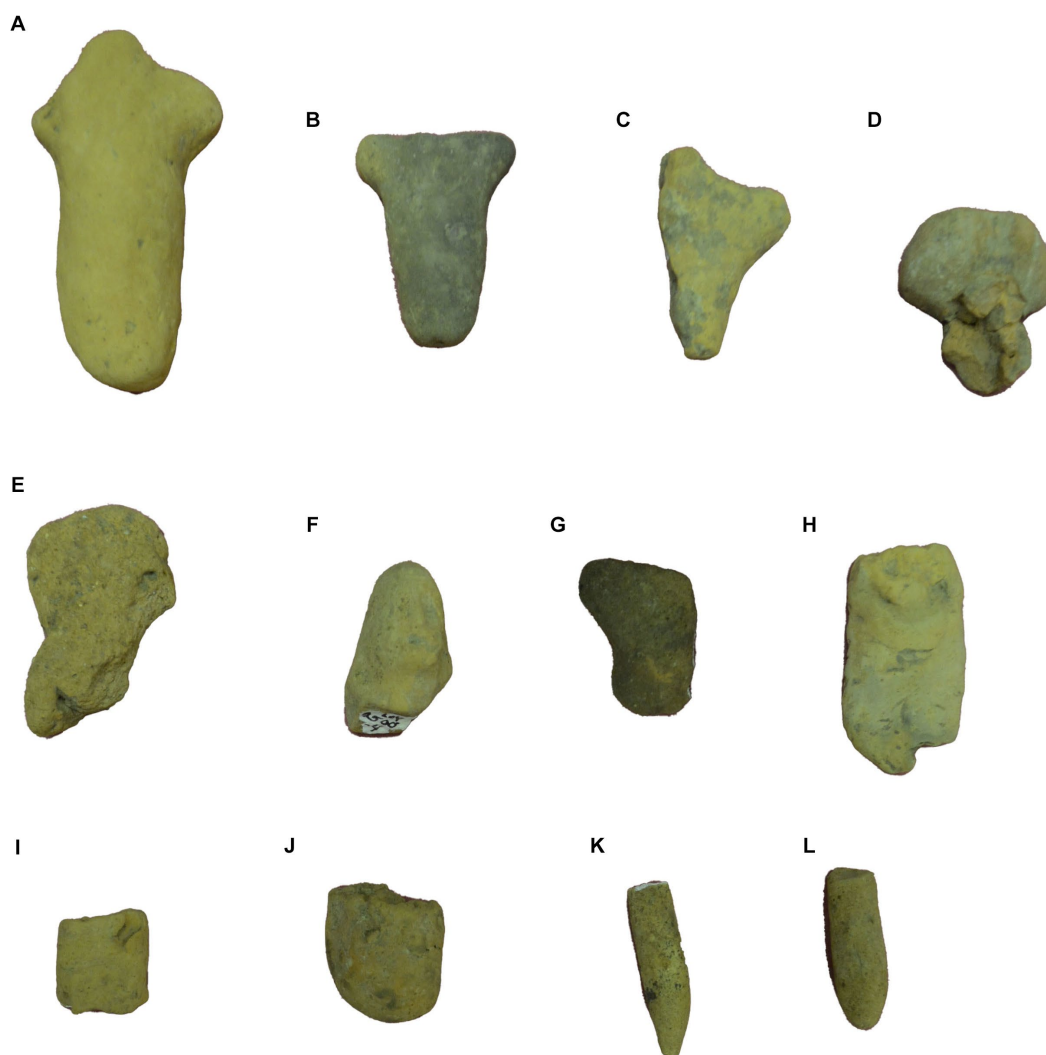


FIGURE 2

Figurines from Loy. Each specimen assigned a sequential letter (A–L) starting top left to bottom right for identification in text.



FIGURE 3
Figurines from Crane. Each specimen assigned a sequential letter (A–O) starting top left to bottom right for identification in text.

from Loy appears to be unbroken yet lacks a head (Figure 2B). There is a small pin-sized hole between the shoulders of this figurine, which may be where a head was attached with a perishable item such as a sliver of wood (Figure 5A). Other objects in the Loy figurine

assemblage are small tubular fragments that may represent portions of limbs (Figures 2J,K).

The largest figurine from Crane (approximately 6 cm) is a figure with legs bent at the knee and slightly offset with the right leg further



forward than the left and feet indicated by thin terminations of pinched clay (Figures 3A, 5B–D). The lack of any anatomical detail on the legs above the knee may indicate clothing such as a skirt or loin cloth. Red coloring on the potential clothing may be remnants of paint or pigment (Figure 5B). This figurine is broken at the chest, but based on similar figurines, it can be assumed that the head was up in the same direction as the feet and may have been supported by arms (e.g., Griffin et al., 1970, Figures 84, 86). The backside has a bulge where the buttocks should be and the curve of the back is clearly modeled. Another figurine fragment from Crane looks similar to this figurine but with less detail (Figures 3E, 6, top). Legs are bent at the knee, and there is an indication of feet via small indentations toward the bottom of the legs. The legs were not formed individually but indicated by an incised line along the front and back. The back line extends to a point that could be representative of buttocks, but there is no corresponding detail on the front legs much above the knee. The back is also entirely

flat with no protrusion of the buttocks or curve of the back (Figure 6, top). Several other lower body fragments from Crane give the indication of legs, buttocks, or the pubic triangle with impressed or incised lines (Figures 3B,E,G,H). For example, the detail on one side is essentially a cross shape produced by two impressed perpendicular lines (Figure 3G). Another figurine fragment appears to have an incised representation of the pubic triangle on one side (Figure 6, bottom). Legs are indicated by a single line down the midpoint, but the overall outline is the rounded, amorphous Ghost style. The opposite side is harder to interpret but may have a line indicating the left and right legs below a triangular protuberance that is broadly reminiscent of the hair or bustle other Middle Woodland figurines (compared Figure 3E with McKern et al., 1945, Plate XXIV). One exceedingly small (<2 cm) figurine mostly consists of a body with the head and feet/legs broken off (Figure 3B). As such, it currently resembles a Casper the Ghost style but may have had individually formed legs/feet prior to breakage.

Other Middle Woodland figurines

Figurines have been recovered from numerous other settlements in the lower Illinois Valley, most notably the Smiling Dan site (Stafford, 1985). Twelve figurines, or fragments thereof, were recovered from Smiling Dan (Stafford, 1985, p. 179) with the majority ($n=7$) falling into the relatively undetailed Casper the Ghost style (Stafford, 1985, Plate 11.5). Several of the heads from Smiling Dan are reminiscent of the Loy and Crane heads with small slits for eyes and mouths with pinched noses and no indications of hair or ears. More detailed figurines from Smiling Dan include the midsection of a presumably male figure with chest definition, a breechcloth, buttocks, straight arms, and semi flexed legs (Stafford, 1985, Plate 11.3, Figure 11.1). A miniature seated figurine has legs tucked to the chest wrapped up by arms that form a continuous circle with no indications of hands (Stafford, 1985, Figure 11.2, Plate 11.4). Buttocks are indicated by a shallow slit. Eye indentations and a nose projection are present along with a probable topknot of hair on top of the head.

Other examples from Illinois valley settlements include figurine fragments at Pool, which include a head with outlined eyes, a mouth with formed lips and a chin, and molded nose and earplugs, as well as a female torso/waist with a pubic triangle indicated and legs with incised lines in kind of sitting position (McGregor, 1958, p. 60–61, Figures 18 and 32). At the nearby Irving site, a single seemingly male upper torso with shoulders/upper arms that were broken off at the neck and below the chest was recovered (McGregor, 1958, p. 71, Figure 34). Gregory Perino recovered an upper torso with roughly molded folded arms at Snyders (Perino, 2006, p. 78–179). Cole and Deuel (1937, Plate XXXIV) provide photographs of a complete figurine from Whitnah. The outline of the Whitnah figurine conforms to the Casper the Ghost style, but legs are indicated with roughly incised lines along with lumps for buttocks and breasts and basic details of the face. Wray and Mac Neish (1961, Figure 11) recovered the upper portion of a figurine from the “Hopewell house” at Weaver. The figurine has the indications of breasts and some details of the face but no arms. The “Y shaped” fired clay object reported by Schoenbeck (1941, p. 65) from the Clear Lake village certainly has the appearance of an upper torso of a Casper the Ghost style figurine. Multiple surface collections indicate that the Blue Creek site (11PK249) is a probable

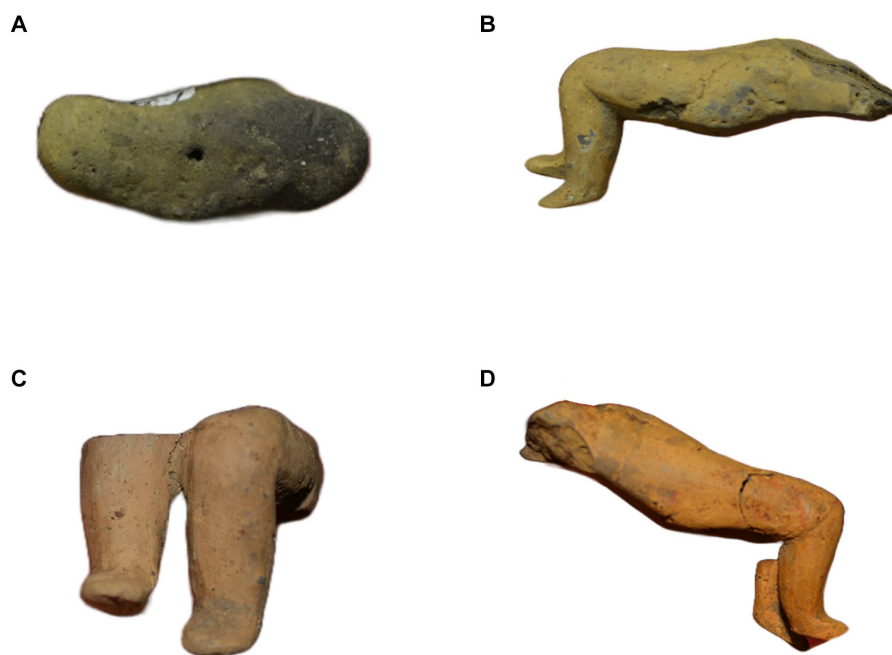


FIGURE 5

Detail images of figurines from Loy (top left) and Crane. Saturation enhanced on the bottom right to highlight a potential red pigment. Each specimen assigned a sequential letter (A–D) starting top left to bottom right for identification in text.

Middle Woodland habitation from which a figurine was recovered with head and legs missing and nubs for arms with pronounced stomach and breasts (Farnsworth and Atwell, 2015, Figure 2.11).

Staab (1984, p. 169) recovered 10 figurines and figurine fragments from Peisker. “Two of the figurine fragments appear to be hands or paws and three are indeterminate body portions. Two fragments are from rather life like human figures. One includes a right hand on which the thumb and fingers were clearly delineated. The other fragment is a carefully modeled, apparently male torso, with a long plait of hair depicted on the back. The other three figurines are crude, stylized human representation” (Staab, 1984, p. 169). Struever (1968) originally described Peisker as a mortuary camp due to the presence of mounds, but Staab’s subsequent excavations in the submound midden revealed a wider range of “subsistence and maintenance tasks” than expected for a mortuary camp (Staab, 1984, p. 2). Another collection of figurines from the Illinois Valley is the group of nine figurines and two heads from a “Hopewellian village site” in Schuyler County that were recovered in association with a plow disturbed human burial (Griffin et al., 1970, p. 82). The Schuyler County figurines have substantial detail representing the face, hair, anatomical features of the body, earspools, clothing, and potentially a headdress (Griffin et al., 1970, Plate 83–85; Koldehoff, 2006, p. 190).

While many detailed figurines have been recovered from habitation sites in the Illinois Valley, none reach the level of detail of the figurines from the Knight Mounds (McKern et al., 1945). Knight is just outside of the Illinois Valley on bluffs overlooking the Mississippi, but it is only a few miles from Snyders (Griffin et al., 1970). The six figurines from Knight are all complete or largely so (e.g., missing a portion of one arm). Five of the six figurines from Knight have highly detailed faces, hands, feet, hairstyles, earspools, clothing, accessories, and accompaniments such as children ($n = 2$) and an atlant

($n = 1$). In addition to the details formed in clay, these figurines were painted in shades of red, white, and black. The one exception to the pattern of highly detailed figurines from Knight is a Casper the Ghost style figurine with no particular details, except on the face with outlined eyes and formed mouth, chin, and nose (Griffin et al., 1970, Plate 79). A figurine recovered from the nearby Ansell-Knight habitation site depicts a head with two detailed hair knots (Deuel, 1952, Plate 94). Two figurines were also recovered in association with burials from the Baehr mound in Brown County, Illinois (Griffin et al., 1970, Plate 80–81). One was recovered from a fiber bag and is well modeled as a complete body but with relatively few details of the hands, feet, and other post-cranial anatomy. Legs and arms are clearly formed but completely attached to the rest of the body. The other Baehr figurine is missing the head and lower portion of the left arm. Legs are separately molded while arms are not but have details of the hands, and the figure is wearing a breech cloth.

Outside of the Illinois Valley, figurines with varying levels of detail have been recovered from settlement sites in the American Bottom (Koldehoff, 2006; Maher, 1989, p. 266–268; Zimmermann et al., 2018, p. 108–110) and further north along the Mississippi River at Putney Landing (Markman, 1988, p. 273, Plate 11.5) and near the Albany Mound group (Farnsworth and Atwell, 2015, p. 96, Figure 4.31) in addition to further south in the Mississippi valley at sites such as Twenhafel (Keller and Carr, 2005, Table 11.1). The largest assemblage of figurines from any particular Middle Woodland site is from Mann in southern Indiana near the confluence of the Wabash and Ohio rivers with figurines largely collected from the habitation areas adjacent to mounds and earthworks (Swartz, 2001b). Much like the overall picture of Middle Woodland figurines, the examples from Mann exhibit a wide range of both types and an in-depth level of detail. Furthermore, the most widely cited examples from Ohio Middle Woodland contexts are



FIGURE 6
Two lower body figurine fragments from Crane.

the group of highly fragmented figurines from the altar of the Turner mound. While these figurines have less detail than those from Knight and do not appear to have additions such as paint, they are highly detailed and clearly not Ghost style figurines. Small numbers of figurines were recovered from other Ohio mounds or enclosures, such as Marietta and Seip. Fewer settlements have been investigated in Ohio as compared with the Illinois valley but relatively amorphous figurine appendage fragments are reported from the McGraw midden (Prufer, 1965, p. 99–100, Figure 6.1).

Figurines are also found at sites in the southeast such as Garden Creek Mound 2 (Keel, 1976, p. 120–122) and Biltmore Mound (Kimball et al., 2010) in North Carolina, Leake and Mandeville in Georgia (Keith, 2013, p. 150; Keller et al., 1962), Crystal River, Block-Sterns, Bell, and Buck Mound in Florida (Brose, 1979, p. 147; Lazarus, 1960), Marksville, Crooks, and Dickerson in Louisiana and Mississippi (Toth, 1988, p. 52), sites in Alabama (Walthall John, 1975, p. 125) as well as further to the west at Mellor in central Missouri (Kay and Johnson, 1977, p. 202), and Trowbridge near Kansas City, Kansas (Johnson, 1979, p. 9).

Figurines as representations of individuals

In comparison to some other parts of the world, clay figurines from eastern North America have garnered insufficient scholarly

attention. Previous research has been largely descriptive, focusing on identifying the figurines as representations of individuals in relation to categories such as social status or gender (e.g., Swartz, 2001a,b). For example, Griffin et al. (1970) and McKern et al. (1945) presented classic descriptions of the detailed and painted figurines from Knight mound and offered the interpretation that these were representations of the deceased who were buried in the mound due to a correlation between the perceived gender of the figurines and the sex of individuals buried at Knight. Others used figurines as one line of evidence to reconstruct the appearance and dress of Middle Woodland peoples (e.g., Deuel, 1952). More recently, Keller and Carr (2005) examined a large sample of Middle Woodland figurines from three different regions in search of how these figurines were representations of gender roles in relation to participation in domestic and mortuary rituals. Keller and Carr ultimately argue that figurines were primarily produced by women for use largely in domestic rituals, while many figurines also depict women in community leadership roles. Similarly, Koldehoff (2006) reports figurines from the American Bottom largely as a descriptive exercise but with a goal of identifying representations of religious or political leaders through an insignia of rank such as headdresses and shamanic costumes. Other reports have focused on technical descriptions of manufacture and assignments of gender and identification of other decorative features (Swartz, 2001a,b; Greenan and Mangold, 2016).³

All of these studies are based on the empirical analysis of figurines and add to our understanding of what these figurines may be representations of. There are, however, two neglected topics to which I call attention here. One place to expand is examining the emergence of figurines as novel material culture in the long-term historical processes in eastern North America in the way that other archeological scholars have studied the emergence of artistic traditions, including figurines, in deep time (e.g., Robb, 2015; Fowles, 2017). For example, little has since been done to expand this line of reasoning since Griffin et al. (1970, p. 87) argued for local development of the figurine tradition in opposition to diffusionist explanations, in that “representations of humans... had a strong development for the first time in the Eastern United States in Hopewellian art.” In other words, why do figurines emerge when and where they do? Why are figurines made by inhabitants of Poverty Point and then seemingly not again until the Middle Woodland?

Second, there is a paucity of research on the agency and materiality of Middle Woodland figurines and what they do as opposed to what they represent (*sensu* Bailey, 2005, 2007, 2014; Fowles, 2017; Marcus, 2019, p. 29–30; Robb, 2015). Some authors have touched on this topic by offering suggestions such as Keller and Carr’s (2005, p. 442) argument that figurines in domestic contexts may relate to fertility rituals, or Koldehoff’s (2006, p. 191) reasoning, following Griffin et al. (1970), that these were related to ancestor veneration. However, to paraphrase a great deal of scholarship, objects make people as much as people make objects (e.g., Dyke and Ruth, 2015), and the active role of figurines has been underexplored. Furthermore, the focus on figurines as representations of particular individuals has led to an

³ A similar focus on interpreting figurines as representations of individuals has characterized figurine studies at Poverty Point (See overview in Connolly, 2008, p. 103–105).

overemphasis on analysis of detailed figurines at the expense of those with less detail. My own descriptions above are guilty of this. As another example, according to McKern et al. (1945, p. 295), a seven-page report of the figurines from Knight only included one sentence on the less detailed Casper the Ghost style figurine. Certainly, more than just the detailed figurines have utility in our understanding. The multitude of Ghost style figurines may not be representations of much detail, but they surely have some purpose. In the following sections, I elaborate upon these two points to highlight important findings about the timing of the emergence of figurines and the materiality of making and using figurines.

Figurines and settling down

Feinman and Neitzel (2023) have recently outlined a detailed model that disentangles subsistence and settlement to highlight the socioeconomic processes associated with increasing residential permanence, aka settling down. These authors separate subsistence and settlement by demonstrating how sedentary settlements are documented among numerous forager societies, how residential mobility and sedentism are not mutually exclusive categories, and how scholars have identified numerous examples to blur the lines between food producing vs. foraging societies. They also highlight the importance of the social aspects entangled with settled life. In their words (Feinman and Neitzel, 2023, p. 11):

People are both inherently social and selfish and are capable of making decisions but are constrained by cognitive limits on their ability to process information. These cognitive limits must be accommodated if larger, more durable communities are to endure. At the same time, to meet key social and environmental challenges, people must cooperate, often in sustained ways. When due to cooperative advantages past community sizes reached critical demographic thresholds, such accommodations involved the forging of new interpersonal arrangements and social institutions whose forms and combinations varied, depending on how these emergent formations were funded. This endeavor has affirmed that the mobile to sedentary transition was truly a dynamic process that took myriad paths with divergent outcomes.

Settling down provides opportunities for new social affiliations, but when these new affiliations push group size past key thresholds, people must address the concomitant scalar stress in new ways. As community size increases up to or beyond the largest threshold of approximately 200 individuals, one way people adapted was through “the advent of more regularly scheduled, routinized, and larger-scale ritual activities” aimed, among other things, at encouraging cooperation among members of dispersed social networks (Feinman and Neitzel, 2023, p. 5). These social affiliations were also associated with new or reorganized institutions that formed overlapping, heterarchical, affiliative identities. Since people are both social and self-interested agents, these interactions with larger communities encourage people to examine the relationship between the individual and the collective in new ways. Furthermore, communities are social and affiliative groupings of individuals and are not equivalent to particular archeological sites or settlements. Communities are multi-scalar, must be continually maintained, and are relational assemblages

of people, objects, and places (e.g., Harris, 2014). Thus, residential site size does not always determine community size, as initially argued with the distinction between natural and imagined communities. Communities may be spread over many settlements, as in translocal or multi-sited village communities (Bernbeck, 2008; Wallis and Pluckhahn, 2023), especially as group size reaches key demographic thresholds associated with semi-settled communities.

It is an intriguing correlation that figurines in eastern North America were made independently among the residents of Poverty Point and then again beginning in the Middle Woodland as both are associated with settling down, monumental integrative ritual facilities, and new institutional arrangements. The resident population size at Poverty Point was unprecedented up to that point in the history of eastern North America. The preponderance of material remains from far off places and labor estimates for earthen monument construction that far exceed local populations demonstrate that the community at Poverty Point encompassed thousands of individuals (e.g., Ortmann and Kidder, 2013). In the Middle Woodland period, large-scale integrative facilities such as monumental enclosures and mounds greatly exceed the size and, therefore, the associated cooperative labor investments of monuments from previous temporal periods, signaling concomitant expansion of social networks (Buikstra and Charles, 1999; Abrams, 2009; Miller, 2021). Most Middle Woodland settlements were generally not large, typically consisting of one to several households (e.g., Stafford and Sant, 1985). Settlements tended to be geographically clustered; however, there is much evidence for connections between these smaller settlements (e.g., Struve, 1965, p. 220; Ruby et al., 2005; Fie, 2006). Ruby et al. (2005) outlined how landscapes of settlements and monuments reflect expanded communities that were organized through interconnected and overlapping scales of the residential, local symbolic, regional symbolic, and sustainable communities. These communities are not necessarily bounded distinct entities but ways to partition our thoughts about the social processes at work behind individual's affiliative decisions. These communities can be traced geographically, as evidenced by the location of spatial clusters of settlements and different types of mounded spaces. In the lower Illinois valley, the size of the burial populations at excavated blufftop mound groups range from 25 to 170 individuals, while the distance between floodplain mound groups corresponds well with what “would have been necessary to accommodate 11 bluff-top mound communities and a sustainable community of 500 persons” (Ruby et al., 2005, p. 136–137). The nested scales of community identified in Illinois and elsewhere are consistent with Feinman and Neitzel's model for how people respond to scalar stress, expanding social networks cross culturally.

What do figurines do?

For anthropomorphic figurines to have a meaningful connection to settling down and affiliating with larger communities, they must have played a social role. Teasing this out begins with viewing figurines as art and recognizing how—following Gell's (1998) anthropological theory of art—“art exerts an agency on people by affecting them in particular ways. It is material culture designed to do relational tasks” (Robb, 2015, p. 636). In other words, Gell's (1998) analysis of art “places its emphasis on the social relations arising around objects that have been designed to be viewed” (Fowles, 2017, p. 680). The

materiality and agency of art are keys in this process. To summarize the “materiality turn” in one phrase, things are “active players in human life rather than simply passive symbols” (Dyke and Ruth, 2015, p. 20). This perspective shifts the line of questioning from *what do figurines mean?* Or *what are they representations of?* to *what do figurines do?* (*sensu* Robb, 2015, p. 636). The question of what figurines do relates to their agency as active “theatrical” objects that “directly address or make overt demands upon the viewer” via their agentive qualities (Fowles, 2017, p. 683). Additionally, Bailey (2005, p. 166) argues that anthropomorphic figurines were one way that people “negotiated and contested individual and group identities through a corporeal means” (see also Marcus, 2019, p. 29–30). “Definition, redefinition, and, critically, the stimuli to think about one’s relationship to others emerge equally from representations” of the body, often at a subconscious level (Bailey, 2005, p. 166). With this background in mind, the following focuses on the agentive power of figurines as miniature three dimensional representations of the human form (Bailey, 2005, 2007, 2014; see also Elsner, 2020 for a similar approach).

Miniatures are abstract representations that do not include all of the detail of the real thing. Thus, certain details can be highlighted to focus attention while others can be suppressed to encourage the viewer to fill in the blanks (Bailey, 2005; Elsner, 2020, p. 4–5; Marcus, 2019, p. 2). As one example, all of the Middle Woodland figurines that include a head have some representation of eyes even those Casper-the-Ghost style figurines that contain few to no other features. Following Gell (1998, p. 12), one reason to highlight the eyes of a miniature is because “eye-contact prompts self-awareness of how one appears to the other, at which point one sees oneself ‘from the outside’ as if one were, oneself, an object.” Additionally, psychological research indicates that interactions with miniatures can transport the viewer to “another mental place, a place where the most rational elements of our existence (such as a perception of time) may be stretched out of shape or compressed” (Bailey, 2005, p. 36). Furthermore, miniaturization changes the relative scale of the viewer, giving the viewer power, comfort, and a sense of control (Bailey, 2005, p. 33; Elsner, 2020, p. 5–6). Elsner (2020, p. 6) argues that the “small worlds” one enters while interacting with miniatures keep their power in the realm of “what if scenarios,” further perpetuating the sense of control or “handleability.”

Miniatures that occur in three dimensions magnify the above qualities for several reasons (Bailey, 2005, p. 38). Miniature 3-D objects can, and should, be handled at a close distance, inviting other senses such as touch into the fold (Bailey, 2005, p. 38; Bailey, 2014; Elsner, 2020, p. 6). Miniature 3-D objects cannot be viewed in toto at one time. Instead, they must be moved in the hand and played with even. There is more agency involved among both the viewer and object in 3-D miniatures than 2-D ones that have a more simplified viewing angle (Bailey, 2005, p. 39; Elsner, 2020, p. 7). The “viewer as handler” interaction that occurs with 3-D miniatures encourages the handler to enter into the world of the figurine where “representations of past and future (including within the mortuary realm of the dead) [or] kinds of social questioning (that may be both supportive and subversive of normative culture)” can be explored (Elsner, 2020, p. 7).

Miniature 3-D anthropomorphic figurines are both body and object, person, and thing (Bailey, 2005; Marcus, 2019, p. 29–30). Figurines are materialized expressions of cultural norms about the body, but they are created by individuals who have the agency of creative expression. These figurines are the “structured structures

predisposed to function as structuring structures” of the body and therefore play a major role in habitus (Bourdieu, 2005, p. 72). As such, objects cannot be understood solely as the work of individuals but instead as part of “art production systems” composed of social units that both make the system while simultaneously being enabled by it (Gell, 1998; Robb, 2015, p. 637). From this social perspective, creation, interaction, and/or play with miniature 3-D anthropomorphic figurines encourages people “to play out narratives of the self and the other” (Bailey, 2005, p. 72; see also Elsner, 2020, p. 6). Furthermore, when many people connected through multi scalar communities interact with figurines, these objects become “one of many mechanisms through which communities interwove their shared (and contested) senses of how individuals were related to one another, indeed of who people were (and were not)” (Bailey, 2005, p. 159).

At this point, the correlation between figurines and settling down within larger communities comes into sharper focus. People do not just make figurines, but figurines mold human perceptions of the individual and their relationship with the larger collective as active, agentive, and theatrical objects (Fowles, 2017). The characteristics of figurines outlined in this section are particularly important because, for one, they demonstrate that people who interact with figurines are thinking about the individual and the collective through multi-scalar relationships. Additionally, figurines contain marks of the individual(s) who created them and the community ideals, art production systems, and other social entities in which they were entangled. Interactions with figurines reinforced and reconstructed aspects of identity as individuals examined their own body in relation to that of figurines (Bailey, 2005, p. 159; Fowles, 2017, p. 684–686).

Discussion

In this study, I explored the correlation between periods of community expansion and the corresponding increased settlement permanence with the materiality of figurines. Increased community size and scalar stress from settling down resulted in new opportunities and obstacles to cooperation when human cognitive networks reached key thresholds. As community size increased past key thresholds, “the actual physical diversity among the living, breathing, flesh, and blood individuals was the greatest risk to community cohesion.” (Bailey, 2005, p. 200). Figurines’ power to encourage people to think through themselves in an increasingly complex social context would have been one materialization of working through issues of the individual, larger communities, and scalar stress. Other more conspicuous practices such as earthen monument construction, feasting, ceremonialism, day-to-day interactions, and emerging institutions were certainly a part of the process (Ruby et al., 2005; Ortmann and Kidder, 2013; Henry and Miller, 2020; Miller, 2021). However, “figurines worked in much subtler and, thus, much more powerful ways, and made people think more deeply (without conscious recognition that they were thinking at all) and absorb the ways in which each person fitted into the larger social group” (Bailey, 2005, p. 201).

However, if figurines have inherent agentive qualities that encourage introspection about the self in relation to others and people have always affiliated with others in communities of varying sizes, why do figurines emerge relatively late in the deep history of eastern North America (and elsewhere for that matter)? Again, there must be a tipping point associated with large affiliative groupings where the

agency of figurines is enacted to play a role in mediating emergent scalar stress. Scholars around the world have pointed to a correlation between the emergence of anthropomorphic clay figurine traditions and the rise of the Neolithic (Bailey, 2005; Robb, 2015; Fowles, 2017; Marcus, 2019). However, evidence demonstrates that the core aspects of the Neolithic—large sedentary villages dependent on food production—do not always co-occur as complete packages, especially in eastern North America (i.e., Feinman and Neitzel, 2023). Eastern North America, where anthropomorphic clay figurines first occur at Poverty Point and not again until over 1,000 years later at Middle Woodland sites, provides an opportunity to examine each of these subsistence and settlement factors independently for correlations with the emergence of figurine traditions. The foragers at Poverty Point and coastal foragers in the Middle Woodland do not fit into the category of Neolithic food producers (Figure 1). Moreover, the small, dispersed hamlets characteristic of settlements across much of the region during the Middle Woodland are a far cry from Neolithic villages, suggesting that the emergence of figurines cannot be tied to village life. While many of the Middle Woodland examples are not from large individual settlements, they are associated with evidence for relatively large but dispersed communities and social networks associated with ceremonial monumentality broadly similar to that observed at Poverty Point. In summary, rather than an association with food production or village life, the strongest correlation exists between figurines and the demographic community thresholds associated with settling down. In addition to disentangling subsistence and settlement, Feinman and Neitzel's (2023) model of the socioeconomic dynamics of settling down also provides specific affiliative thresholds at which scalar stress can be expected as opposed to reference to more vague thresholds, such as the emergence of village societies, agriculture, or the Neolithic utilized in other discussions of early figurines.

In the lower Illinois River Valley, there is evidence for the emergence of geographic territories inhabited by interrelated groups of individual households during the Middle Woodland (Ruby et al., 2005). However, individuals, families, and larger communities were not economically or socially self-sufficient. Hence, the creation, maintenance, and expansion of alliances and other connections and the material evidence occur at mound centers and settlements. However, these larger communities also created new tensions across the micro, meso, and macro scales of the social landscape. Figurines were one materialization of connections through shared practices and attempts at alleviating tensions of individuals and groups.

The examples from the Middle Woodland do not represent a singular, monolithic figurine tradition as there was a wide range of variation in Middle Woodland ceramic figurines across eastern North America. However, considering the incredible plasticity of clay as a medium, the variation is relatively restricted in Middle Woodland figurines and in many early figurine traditions (Bailey, 2005, p. 146). The recognition of similar themes and styles across wide regions must signal shared ideas and practices (e.g., Griffin et al., 1970, p. 87; Keller and Carr, 2005, Table 11.1, 440; McKern et al., 1945, p. 300). Despite claims for their role in exchange (e.g., Struever and Houart, 1972, p. 77), the predominance of evidence suggests that these figurines were non-circulating items for personal use (Griffin et al., 1970, p. 87; Keller and Carr, 2005, p. 440). For example, the paste of figurines from any particular site is always similar to local pottery (Johnson, 1979, p. 91; Keel, 1976, p. 122; Keller et al., 1962, p. 344, 351; Walthall John, 1975, p. 127; Koldehoff, 2006, p. 188). These broad similarities among

extensive local variation in the absence of widespread exchange of figurines suggest the presence of local communities of practice and broader constellations of practice, which signal another way figurines played a role in community formation and maintenance during the Middle Woodland period.

Examining the community aspect of what figurines do provide insights into all figurines, regardless of a variation in detail, artisan skill level, or time invested in manufacture. It is reasonable to contend that figurines which lack detail (e.g., Casper the Ghost style) may have been made by individuals of different ages and/or skill levels than the finely detailed figurines that have garnered the most scholarly attention. For example, childhood development research provides evidence to support the intuitively satisfying assumption that detail and technical execution in anthropomorphic clay figurines increase with age and experience (Brown, 1975, 1984). Admittedly, it is also possible that the level of detail could be attributed to factors related to lack of time investment by a skilled artisan. However, the inclusion of a Casper-the-Ghost figurine among the detailed and painted figurines in Knight suggests that the former was made by an artist with less skill (Griffin et al., 1970). If less detailed figurines were made by novices, the preponderance of undetailed figurines across a wide range of sites is evidence that many individuals, not just specialized artisans, were engaging with miniature 3-D anthropomorphic figurines. That said, many figurines from Middle Woodland mounds or burial contexts (e.g., Knight, Schuyler County, and Turner but not Baehr) demonstrate a comparatively high level of execution and detail, perhaps suggesting a connection with ritual craft specialists (Spielmann, 1998). The wide range of detail, or lack thereof, in figurines from settlements (e.g., Crane, Loy, Smiling Dan, Mann) is what would be expected if individuals of many different skill levels were producing figurines at these sites. This conclusion is not surprising when viewing figurines as agents for stimulating thought about the self and social relationships. This interpretation also assigns agency to people of different skill levels by recognizing what figurines do for children or novices. It also allows scholars to extract information from all figurines, even those that are not obvious representations of particular physical features.

The wide diversity of figurines from ancient eastern North America most certainly had a multiplicity of meanings and uses (Bailey, 2005, p. 84). Perhaps some were representations of political leaders, ancestors, or deities, whereas perhaps figurines deposited in mounds were involved in institutional rituals, but the recovery of figurines in domestic refuse could also logically be interpreted as evidence for their use as toys (Zimmermann et al., 2018, p. 108) as there is no independent evidence of ritual activity such as caching or arranging in elaborately staged scenes at settlements (see Bailey, 2005, p. 26–27; Kamp, 2001, p. 236; Marcus, 2019, p. 21). Most importantly, “each of these anecdotal equivalences is not an interpretation; each is merely a suggestion that fails to engage the real essences of figurines as active visual culture” (Bailey, 2005, p. 84). In this vein, there is abundant evidence to show the social agency of figurines was enacted independently in divergent pathways to settled life. Figurines emerged during times when communities were expanding to key demographic thresholds and were likely key components in making communities. The correlation between periods of semi-settled life, larger communities, widespread ceremonial practices, monumental architecture, and the emergence of miniature 3-D anthropomorphic clay figurines in eastern North America speaks to the importance of the latter in the navigation of new affiliative decisions.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: Illinois State Museum.

Author contributions

GLM: Writing – original draft.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Acknowledgments

The author thanks Gary Feinman and Victor Thompson for the opportunity to contribute to this research collection and Ken Farnsworth for providing essential background on Loy and Crane as

well as for always sharing his encyclopedic knowledge of the Middle Woodland in the Illinois valley. The Illinois State Museum provided access to the Loy and Crane site collections and field records. Two reviewers provided feedback to improve the content and clarity of the manuscript.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Abrams, E. M. (2009). Hopewell archaeology: a view from the northern woodlands. *J. Archaeol. Res.* 17, 169–204. doi: 10.1007/s10814-008-9028-0
- Asch, D. L., and Asch, N. B. (1985). "Archaeobotany" in *Massey and Archie*. eds. K. Farnsworth and A. Koski (Kampsville: Center for American Archaeology), 162–220.
- Asch, D. L., Farnsworth, K. B., and Asch, N. B. (1979). "Middle woodland subsistence and settlement in west Central Illinois" in *Hopewell archaeology*. eds. D. Brose and N. Greber (Kent: Kent State University Press), 80–85.
- Bailey, D. (2005). *Prehistoric Figurines: Representation and corporeality in the Neolithic*. New York: Routledge.
- Bailey, D. (2007). "The anti-rhetorical power of representational absence: incomplete Figurines from the Balkan Neolithic" in *Image and imagination: A global prehistory of figurative representation*. eds. C. Renfrew and I. Morley (Cambridge: McDonald Institute of Archaeological Research, University of Cambridge), 117–126.
- Bailey, D. (2014). "Touch and the Cheirotic apprehension of prehistoric Figurines" in *Sculpture and touch*. ed. P. Dent (Farnham: Ashgate), 27–43.
- Bernbeck, R. (2008). "An archaeology of multi-sited communities" in *The archaeology of mobility: Old World and New World nomadism*. eds. H. Barnard and W. Wendrich (Los Angeles: Cotsen Institute of Archaeology UCLA), 43–77.
- Bourdieu, P. (2005). *Outline of a theory of practice*. Translated by NiceR. Cambridge University Press, Cambridge.
- Brose, D. S. (1979). "An interpretation of Hopewellian traits in Florida" in *Hopewell archaeology*. eds. D. Brose and N. Greber (Kent: Kent State University Press), 141–149.
- Brown, E. V. (1975). Developmental characteristics of clay figures made by children from age three through age eleven. *Stud. Art Educ.* 16, 45–53. doi: 10.2307/1320125
- Brown, E. V. (1984). Developmental characteristics of clay figures made by children: 1970 to 1981. *Stud. Art Educ.* 26, 56–60. doi: 10.2307/1320801
- Buikstra, J. E., and Charles, D. K. (1999). "Centering the ancestors: cemeteries, mounds, and sacred landscapes of the ancient north American midcontinent" in *Archaeologies of landscape*. eds. W. Ashmore and A. Bernard Knapp (Malden: Blackwell), 201–228.
- Cantwell, A.-M. (1980). Middle woodland dog ceremonialism in Illinois. *Wisconsin Archaeol.* 61, 480–496.
- Carr, C. (1982). *Handbook on soil resistivity surveying*. Center for American Archaeology Press, Kampsville.
- Carr, C. (2022). *Being Scioto Hopewell: Ritual Drama and personhood in cross-cultural perspective*. Springer Nature, Boston.
- Charles, D. K. (2012). "Origins of the Hopewell phenomenon" in *The Oxford handbook of north American archaeology*. ed. T. Pauketat (New York: Oxford University Press), 471–482.
- Charles, D. K., and Buikstra, J. (2006). *Recreating Hopewell: New perspectives on middle woodland in eastern North America*. University Press of Florida, Gainesville.
- Cole, F. C., and Deuel, T. (1937). *Rediscovering Illinois: Archaeological explorations in and around Fulton County*. University of Chicago Press, Chicago.
- Connolly, R. P. (2008). Scratching the surface: the role of surface collections in solving the "mystery" of poverty point. *Louisiana Archaeol.* 35, 79–115.
- Cook, D. C., and Farnsworth, K. B. (1981). Clay funerary masks in Illinois Hopewell. *Midcont. J. Archaeol.* 6, 3–15.
- Deuel, T. (1952). "Hopewellian dress in Illinois" in *Archaeology of eastern United States*. ed. J. B. Griffin (Chicago: University of Chicago Press), 165–175.
- Dyke, V., and Ruth, M. (2015). Materiality in practice: an introduction. In *Practicing materiality*, edited by Dyke R. Van, pp. 3–32. University of Arizona Press, Tucson.
- Elsner, J. (2020). "Introduction" in *Figurines: Figuration and the sense of scale* (Oxford: Oxford University Press), 1–10.
- Farnsworth, K. B., and Atwell, K. A. (2015). *Excavations at the Blue Island and Naples-Russell mounds and related Hopewellian sites in the lower Illinois Valley; Urbana-Champaign: Illinois State Archaeological Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign*.
- Feinman, G. M., and Neitzel, J. E. (2023). The social dynamics of settling down. *J. Anthropol. Archaeol.* 69:101468. doi: 10.1016/j.jaa.2022.101468
- Fie, S. M. (2006). "Visiting in the interaction sphere: ceramic exchange and interaction in the lower Illinois Valley" in *Recreating Hopewell*. eds. D. Charles and J. Buikstra (Tallahassee: University of Florida Press), 427–445.
- Ford, J. A., and Webb, C. H. (1956). Poverty point, a late archaic site in Louisiana. In: *Anthropological papers of the American Museum of Natural History* 46(1) New York.
- Fowles, S. (2017). Absorption, theatricality and the image in deep time. *Camb. Archaeol. J.* 27, 679–689. doi: 10.1017/S0959774317000701
- Gell, A. (1998). *Art and agency: An anthropological theory*. Clarendon Press, Oxford.
- Gibson, J. L. (2001). *The ancient mounds of poverty point: Place of rings*. University Press of Florida, Tuscaloosa.
- Greenan, M., and Mangold, W. L. (2016). Evidence for figurine manufacturing techniques employed by Mann site artists. *Indiana Archaeol.* 11, 9–25.
- Griffin, J. B., Flanders, R. E., and Titterton, P. F. (1970). *The burial complexes of the knight and Norton mounds in Illinois and Michigan*. University of Michigan Museum of Anthropological Archaeology, Ann Arbor.
- Harris, O. J. T. (2014). (re) assembling communities. *J. Archaeol. Method Theory* 21, 76–97. doi: 10.1007/s10816-012-9138-3

- Henry, E. R., and Barrier, C. R. (2016). The organization of dissonance in Adena-Hopewell societies of eastern North America. *World Archaeology*, 48:87–109.
- Henry, E. R., Mickelson, A. M., and Mickelson, M. E. (2020). Documenting ceremonial situations and institutional change at Middle Woodland geometric enclosures in central Kentucky. *Midcontinental Journal of Archaeology*, 45:203–225.
- Henry, E. R., and Miller, G. L. (2020). Toward a situational approach to understanding middle woodland societies in the north American midcontinent. *Midcont. J. Archaeol.* 45, 187–202. doi: 10.2307/26989076
- Henry, E. R., Mueller, N. G., and Jones, M. B. (2021). Ritual dispositions, enclosures, and the passing of time: a biographical perspective on the Winchester farm earthwork in Central Kentucky, USA. *J. Anthropol. Archaeol.* 62:101294. doi: 10.1016/j.jaa.2021.101294
- Herrmann, J. T., King, J. L., and Buikstra, J. E. (2014). Mapping the internal structure of Hopewell tumuli in the lower Illinois River valley through archaeological geophysics. *Adv. Archaeol. Pract.* 2, 164–179. doi: 10.7183/2326-3768.2.3.164
- Johnson, A. E. (1979). “Kansas City Hopewell” in *Hopewell archaeology: The Chillicothe conference*. eds. D. Brose and N. Greber (Kent: Kent State University Press), 86–93.
- Kamp, K. A. (2001). Prehistoric children working and playing: a southwestern Case study in learning ceramics. *J. Anthropol. Res.* 57, 427–450. doi: 10.1086/jar.57.4.3631354
- Kay, M., and Johnson, A. E. (1977). Havana tradition chronology of Central Missouri. *Midcont. J. Archaeol.* 2, 195–217.
- Keel, B. (1976). *Cherokee archaeology*. University of Tennessee Press, Knoxville.
- Keith, S. (2013). “The woodland period cultural landscape of the Leake site complex” in *Early and middle woodland landscapes of the southeast*. eds. A. P. Wright and E. R. Henry (Gainesville: University Press of Florida), 138–152.
- Kellar, J. H., Kelly, A. R., and McMichael, E. V. (1962). The Mandeville site in Southwest Georgia. *Am. Antiq.* 27, 336–355. doi: 10.2307/277800
- Keller, C., and Carr, C. (2005). “Gender, role, prestige, and ritual interaction across the Ohio, Mann, and Havana Hopewellian regions, as evidenced by ceramic Figurines” in *Gathering Hopewell: Society, ritual, and ritual interaction*. eds. C. Carr and D. Troy Case (Boston: Springer), 428–460.
- Kidder, T. R. (2006). Climate change and the archaic to woodland transition (3000–2500 Cal BP) in the Mississippi River basin. *Am. Antiq.* 71, 195–231. doi: 10.2307/40035903
- Kidder, T. R., Henry, E. R., and Arco, L. J. (2018). Rapid climate change-induced collapse of hunter-gatherer societies in the lower Mississippi River valley between ca. 3300 and 2780 cal yr BP. *Sci. China Earth Sci.* 61, 178–189. doi: 10.1007/s11430-017-9128-8
- Kimball, L. R., Whyte, T. R., and Crites, G. D. (2010). The Biltmore mound and Hopewellian mound use in the southern Appalachians. *Southeast. Archaeol.* 29, 44–58. doi: 10.1179/sea.2010.29.1.004
- King, J. L., Buikstra, J. E., and Charles, D. K. (2011). Time and archaeological traditions in the lower Illinois Valley. *Am. Antiq.* 76, 500–528. doi: 10.7183/0002-7316.76.3.500
- Koldehoff, B. (2006). Hopewellian figurines from the southern American Bottom. *Illinois Archaeology* 18:185–193
- Lazarus, W. C. (1960). Human Figurines from the coast of Northwest Florida. *Florida Anthropol* 8, 61–70.
- Lepper, B. T., Leone, K. L., Jakes, K. A., Pansing, L. L., and Pickard, W. H. (2014). Radiocarbon dates on textile and bark samples from the central grave of the Adena mound (33RO1), Chillicothe, Ohio. *Midcont. J. Archaeol.* 39, 201–221. doi: 10.1179/2327427113Y.0000000008
- Maher, T. O. (1989). “The middle woodland ceramic assemblage. In the holding site” in *American bottom archaeology, FAI-270 site reports*. eds. A. Fortier, T. Maher, J. A. Williams, M. C. Meinkoth, K. E. Parker and L. S. Kelly, vol. 19 (Urbana: University of Illinois Press), 125–318.
- Marcus, J. (2019). Studying Figurines. *J. Archaeol. Res.* 27, 1–47. doi: 10.1007/s10814-018-9117-7
- Markman, C. (1988). “Hopewell interaction sphere artifacts” in *Putney landing: Archaeological investigations at a Havana Hopewell settlement on the Mississippi River west-Central Illinois*. ed. C. Markman (Dekalb: Northern Illinois University Department of Anthropology), 270–290.
- McGregor, J. C. (1958). *The Pool and Irving villages: A study of Hopewell occupation in the Illinois River valley*. University of Illinois Press, Urbana.
- McKern, W. C., Titterton, P. F., and Griffin, J. B. (1945). Painted pottery Figurines from Illinois. *Am. Antiq.* 10, 295–302. doi: 10.2307/275132
- Miller, G. L. (2021). Ritual, labor mobilization, and monumental construction in small-scale societies: the Case of Adena and Hopewell in the middle Ohio River valley. *Curr. Anthropol.* 62, 164–197. doi: 10.1086/713764
- Miller, G. L., and Farnsworth, K. B. (2023). Crane and Loy: middle woodland settlements on Macoupin Creek, Greene County, Illinois. In: *Paper presented at the Midwest archaeological conference*, Bowling Green, Kentucky.
- Mueller, N. G., Spengler III, R. N., Glenn, A., and Lama, K. (2020). Bison, anthropogenic fire, and the origins of agriculture in eastern North America. *Anthropocene Rev* 8, 141–158. doi: 10.1177/2053019620961119
- Ortmann, A. L., and Kidder, T. R. (2013). Building mound a at poverty point, Louisiana: monumental public architecture, ritual practice, and implications for hunter-gatherer complexity. *Geoarchaeology* 28, 66–86. doi: 10.1002/gea.21430
- Perino, G. (2006). The 1955 Snyders Village site excavations, Calhoun County, Illinois. In *Illinois Hopewell and late woodland mounds*, by Perino G. and edited by K. Farnsworth and M. Wiant, pp. 141–207. University of Illinois, Urbana.
- Prufert, O. H. (1965). “Miscellaneous artifacts” in *The McGraw site: A study in Hopewellian dynamics*. ed. O. H. Prufert (Cleveland: Cleveland Museum of Natural History), 98–103.
- Rafferty, S. (2005). “The Many Messages of Death: Mortuary Practices in the Ohio Valley and Northeast,” in *Woodland Period Systematics in the Middle Ohio Valley*, edited by D. Applegate and Mainfort R. C. Jr., 150–67. Tuscaloosa: University of Alabama Press.
- Robb, J. (2015). Prehistoric art in Europe: a deep-time social history. *Am. Antiq.* 80, 635–654. doi: 10.7183/0002-7316.80.4.635
- Ruby, B. J., Carr, C., and Charles, D. K. (2005). “Community organizations in the Scioto, Mann, and Havana Hopewellian regions: a comparative perspective” in *Gathering Hopewell: Society, ritual, and ritual interaction*. eds. C. Carr and D. Troy Case (Boston: Springer), 119–176.
- Schoenbeck, E. (1941). Cultural objects of clear Lake Village site. *Trans Illinois State Acad Sci* 34:65.
- Seeman, M. F. (2004). “Hopewell art in Hopewell places” in *Hero, hawk, and open hand: American Indian art of the ancient Midwest and south*. ed. R. F. Townsend (New Haven: Yale University Press), 57–71.
- Seeman, M. F. (2020). “Twenty-first century Hopewell” in *Encountering Hopewell in the twenty-first century, Ohio and beyond*. eds. B. G. Redmond, B. J. Ruby and J. Burks, vol. 2 (Akron: University of Akron Press), 313–342.
- Smith, B. D. (1992). “Hopewellian farmers of eastern North America” in *Rivers of change*. ed. B. Smith (Tuscaloosa: The University of Alabama Press), 201–248.
- Spielmann, K. A. (1998). Ritual craft specialists in middle range societies. *Archeol Papers Am Anthropol Assoc* 8, 153–159. doi: 10.1525/ap3a.1998.8.1.153
- Staab, M. L. (1984). Peisker: An examination of middle woodland site function in the lower Illinois Valley. PhD Dissertation, Department of Anthropology, The University of Iowa.
- Stafford, B. D. (1985). “Overview of material remains” in *Smiling Dan: Structure and function at a middle woodland settlement in the Illinois Valley*. eds. B. Stafford and M. Sant (Kampsville: Center for American Archaeology), 166–182.
- Stafford, B. D., and Sant, M. B. (1985). *Smiling Dan: Structure and function at a middle woodland settlement in the Illinois Valley*. Center for American Archaeology Research: Kampsville.
- Struever, S. (1965). Middle woodland culture history in the Great Lakes riverine area. *Am. Antiq.* 31, 211–223. doi: 10.2307/2693986
- Struever, S. (1968). “Woodland subsistence-settlement Systems in the Lower Illinois Valley” in *Archeology in cultural systems*. ed. L. R. Binford, Chicago: Aldine Publishing Co. 285–312.
- Struever, S., and Houart, G. L. (1972). “An analysis of the Hopewell interaction sphere” in *Social exchange and interaction*. ed. E. Wilmsen (Ann Arbor: Museum of Anthropology, University of Michigan), 47–147.
- Swartz, B. K. (2001a). “A survey of Adena-Hopewell (Scioto) anthropomorphic portraiture” in *The New World figurine project*. eds. T. Stocker and C. L. Otis, vol. 2 (Provo: Research Press, Brigham Young University), 225–252.
- Swartz, B. K. (2001b). “Middle woodland Figurines from the Mann site, Southwest Indiana” in *The New World figurine project*. eds. T. Stocker and C. L. Otis, vol. 2 (Provo: Research Press, Brigham Young University), 253–270.
- Toth, E. A. (1988). *Early Marksville phases in the lower Mississippi Valley: A study of culture contact dynamics*. Mississippi Department of Archives and History, Jackson.
- Wallis, N. J., and Pluckhahn, T. J. (2023). Understanding multi-sited early village communities of the American southeast through categorical identities and relational connections. *J. Anthropol. Archaeol.* 71:101527. doi: 10.1016/j.jaa.2023.101527
- Walshall John, A. (1975). Ceramic Figurines, Porter Hopewell, and Middle Woodland Interaction. *Florida Anthropol* 28, 125–140.
- Weiland, A. W., Crawford, L. J., Ruby, B. J., and Purtil, M. P. (2023). Feasting at a world center shrine: Paleoethnobotanical and micromorphological investigations of a Woodhenge earth oven. *J. Archaeol. Method Theory*. doi: 10.1007/s10816-023-09620-x
- Wray, D., and Mac Neish, R. S. (1961). *The Hopewellian and weaver occupations of the weaver site, Fulton County, Illinois*. Springfield: Illinois State Museum, Springfield.
- Wright, A. P. (2020). *Garden Creek; the archaeology of interaction in middle woodland Appalachia*. University of Alabama Press, Tuscaloosa.
- Wright, A. P., and Henry, E. R. (2013). *Early and middle woodland landscapes of the southeast*. University Press of Florida, Tallahassee.
- Zimmermann, J. A., Cisneros, A., Haun, L., Leslie, K., Roberts, K., Sandberg, A., et al. (2018). Hopewellian occupations at the Gehring site (11MS99) in the American bottom. *Illinois Archaeol* 30, 80–119.



OPEN ACCESS

EDITED BY

David Manuel Carballo,
Boston University, United States

REVIEWED BY

Chris Rodning,
Tulane University, United States
Richard Edward Blanton,
Purdue University, United States

*CORRESPONDENCE

Rachel Cajigas
✉ rmcajigas@ua.edu

RECEIVED 20 December 2023

ACCEPTED 06 March 2024

PUBLISHED 28 March 2024

CITATION

Cajigas R, Sanger MC, Semon AM,
Thompson VD, Garland CJ, Blair EH and
Thomas DH (2024) Sequential villages and
settling down on the southeast U.S. coast.
Front. Hum. Dyn. 6:1358614.
doi: 10.3389/fhumd.2024.1358614

COPYRIGHT

© 2024 Cajigas, Sanger, Semon, Thompson,
Garland, Blair and Thomas. This is an open-
access article distributed under the terms of
the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction
in other forums is permitted, provided the
original author(s) and the copyright owner(s)
are credited and that the original publication
in this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted
which does not comply with these terms.

Sequential villages and settling down on the southeast U.S. coast

Rachel Cajigas^{1*}, Matthew C. Sanger², Anna M. Semon³,
Victor D. Thompson⁴, Carey J. Garland⁴, Elliot H. Blair¹ and
David Hurst Thomas³

¹Department of Anthropology, University of Alabama, Tuscaloosa, AL, United States, ²Smithsonian Institution, National Museum of the American Indian, Washington, DC, United States, ³Division of Anthropology, American Museum of Natural History, New York, NY, United States, ⁴Department of Anthropology, University of Georgia, Athens, GA, United States

The adoption of more sedentary residential practices is a long process in which groups shift in size, permanence, makeup, and even location in response to the social, demographic, ecological, and subsistence pressures associated with settling down. Coastal peoples living in the Southeast U.S. are among the first to adopt more sedentary lifeways in North America as evidenced by their creation of dozens of large circular or arcing shell middens during the end of the Middle Holocene and start of the Late Holocene. Relying on material culture studies and AMS radiocarbon data refined using Bayesian statistical modeling, we investigate the sequential establishment and abandonment of three village sites built over more than 300 years and located only a few kilometers apart. These studies reveal important insights into the process of adopting more sedentary practices in the region and how local communities adapted to associated pressures.

KEYWORDS

archaeology, radiocarbon dating, Bayesian modeling, southeast U.S., Late Archaic

1 Introduction

The formation of permanent, sedentary communities in the coastal southeastern United States was a phenomenon that coincided with complex social and environmental/ecological changes (Thompson and Andrus, 2011; Garland et al., 2022). Village formation and sedentism in this region was not reliant on domesticated resources, and the Late Archaic (5000–3,000 cal BP) communities from the Georgia coast are examples of alternate and diverse paths to sedentism that diverge from traditional models that view agricultural products as critical to less mobile lifeways (Russo, 1991). These communities are also notable as they created a series of circular or arcuate shell middens, known as shell rings, across much of the southeastern coastline. These middens contain vast amounts of information about the ring building communities, including how they adopted increasingly less mobile lifeways. Based on prior research, some archaeologists view these communities as having complex settlement patterns, with a persistent core group of people living in place over multiple seasons of the year, with cyclic gatherings of larger populations (Russo, 2004; Sanger and Ogdén, 2018; Sanger et al., 2020). Resource availability and diverse subsistence practices contributed to the possibility of multi-season occupation on the coast (Russo, 1991; Sanger, 2017b; Sanger et al., 2020; Colaninno, 2022). Communities, however, required regional interaction and cooperation to maintain environmentally sustainable subsistence systems within the estuary and island ecological landscape (Thompson, 2018, 2022). Native Americans participated in cooperative fishing techniques and shell-fish mass capture practices that supported feasting events and

established and solidified relationships (Thompson, 2022; Garland and Thompson, 2023). Beyond local ties, these communities negotiated wide social networks, as evidenced by the presence of long-distance procurement and exchange (Sanger et al., 2019). Ring inhabitants were also responsible for significant technological innovations, such as the earliest pottery in North America, and built the earliest permanent architecture, which some consider monumental (Saunders and Russo, 2011; Russo, 2014; Saunders, 2014).

While archaeologists have viewed coastal residents among the earliest people to have “settled down” and lived in villages, the precise nature by which these shifting residential practices were undertaken is still unknown. Among the most pressing questions is how communities established each of the shell rings, whether ring use changed over time, and how connected different ring groups were to one another. These questions are particularly important on landforms, including the many barrier islands that line the Georgia Bight, on which multiple rings are commonly found. This poorly understood pattern of multiple rings located near one another could be interpreted in many ways. It could represent a small population that sequentially moved between village sites over time or a larger group that used multiple sites at the same time, or multiple contemporary groups living at each ring, or something else altogether.

To address these, and other questions, we focus in on our recent Bayesian modeling of radiocarbon dates from three Late Archaic shell ring sites on St. Catherines Island, GA (see Thompson et al., 2024 for regional perspective). Previous archaeological research on St. Catherines Island focused on the two known shell ring sites that were identified by archaeologists prior to 2010 (see discussion in Section 1.3). This paper presents information on the recent archaeological discovery of a third shell ring on St. Catherines, including new radiocarbon dates that characterize the timing of shell ring construction.

This precise chronology based on these new dates helps us to better characterize the timing of the dynamic environmental and social processes co-occurring, including how long people occupied these villages, where people were living at the same time, and the linkages between villages on St. Catherines Island.

1.1 Late Archaic environmental setting, resources and subsistence of the people of the Georgia Bight

The U.S. Southeast Atlantic coast is a dynamic geological environment with diverse ecological habitats. The Atlantic coastline experienced significant changes throughout the early-to-middle Holocene due to glacial meltwater inputs and isostatic rebound following the Last Glacial Maximum causing sea-level changes (Turck and Alexander, 2013). On a local scale, these coastal environments experience dynamic changes due to erosional processes from meteorological events such as hurricanes, as well as frequent tidal fluctuations. The Georgia Bight, the geographic focus of this case study, is composed of various micro-environments such as alluvial landscapes, tidal shorelines, estuaries, barrier islands, and marshlands; all of which have archaeological evidence of variable settlement-subsistence patterns (Turck and Alexander, 2013).

Although the precise timing and magnitude of sea-level fluctuations in this region is debated, archaeologists believe intensive

settlement began on the Georgia coast during the middle-to-late Holocene during a time when sea-level was stabilized. During the Late Archaic period (5000–3,000 cal BP), sea levels were lower than modern levels and continued to fluctuate, impacting coastal habitats and settlement patterns in different ways (Thompson and Turck, 2009; Thompson and Worth, 2011; DePratter and Thompson, 2013; Turck and Thompson, 2016).

The Georgia Bight is home to species-rich coastal sites with a 5,000-year fishing tradition. These communities were home to skilled fishers who managed a diverse estuarine ecosystem, using strategies specific to local conditions and environments (Reitz, 2014; Colaninno, 2022; Reitz et al., 2022). Seasonality studies on hard clam procurement in this region suggest that the coast was not seasonally abandoned, and year-round adaptation has a long history in this environment (Quitmyer et al., 1997). Late Archaic foragers developed shell fishing practices that lasted thousands of years, continuing even after intensive maize agriculture was adopted c. AD 1400 (Thomas, 2014). The long-term stability of these coastal ecosystems suggest Indigenous oyster collection practices contributed to larger regional sustainability (Thompson et al., 2020; Garland and Thompson, 2023).

Terrestrial resources are abundant in the mature maritime forests of this region. There are ample mast resources, which would have been seasonally available to people as well as browsers, such as white-tailed deer. Ethnohistoric and archaeological data indicate that large terrestrial animals such as bear and alligator were hunted, and there is also archaeological evidence of brackish and freshwater turtle species, racoon, possum, wild turkey, rabbits, and squirrel in midden deposits. These resources have been shown in previously published experimental archaeology studies to have high post-encounter return rates (Thomas et al., 2008; Thomas, 2014).

1.2 Shell ring builders of the South Atlantic Bight

Native Americans formed circular shell rings in the Southeast U.S. along the Atlantic coast. There are more than fifty known shell rings in the region: large, circular, or arcuate-shaped deposits composed primarily of oyster shell and midden deposits with shell-free interiors (Russo and Heide, 2001). These rings, ranging in size from 40 to 250 m across, are among earliest surviving architecture from the Late Archaic period (Russo, 2006).

The stretch along the South Atlantic Bight has the greatest density of these structures, with most being constructed during the Late Archaic period. Some researchers suggest that shell rings were built intentionally as monumental constructions (Saunders and Russo, 2011), but most consider these shell deposits as evidence of the earliest village sites in the region (Sanger, 2015a; Thompson, 2018, 2022; Garland et al., 2022).

Much of the archaeological research on shell rings has focused on understanding the nature of the construction of the deposits, and whether they are midden deposits created from gradual accumulations of village refuse (Trinkley, 1985), feasting activity causing rapid deposition of material (Saunders, 2002, 2004, 2014), or through shifts in function over time (Thompson, 2007). These models have been assessed through seasonality studies of shellfish (Thompson and Andrus, 2011; Andrus and Thompson, 2012), vertebrate and invertebrate faunal analyses (Colaninno and Compton, 2018;

Cannarozzi and Kowalewski, 2019; Colaninno, 2022), shallow geophysics (Thompson et al., 2004; Sanger and Thomas, 2010; Mahar, 2013); and evidence from archaeological features and deposits (Thompson, 2007; Sanger, 2017b; Cajigas et al., 2023).

Within the South Atlantic Bight, it is common for there to be multiple rings located within relatively short distances of one another. The majority of known rings are located on barrier islands, thin and long landforms separated from the mainland by rich marshlands. On several islands, including St. Simons and Hilton Head, there are at least two known rings located only a short walk from one another (less than 5 km), while on other islands, including Sapelo and Fig Island, there are multiple rings within sight of one another (Trinkley, 1985; Saunders, 2002; Marrinan, 2010; Garland and Thompson, 2023). The results provided in this paper are part of a broader project designed to better understand the relationship between shell rings, including those located on the same island.

Indigenous people largely stopped building shell rings around 3,600 cal BP, at the end of the Archaic period, possibly corresponding to sea-level changes (Sanger, 2010). On St. Catherines Island, there are very few dates associated with shell at the Terminal Archaic period, indicating there was a hiatus in shell midden construction (Thomas, 2008).

1.3 The two shell rings on St. Catherines Island

Located 30 miles south of Savannah, Georgia, extensive archaeological research conducted by David Hurst Thomas on St. Catherines Island had two identified shell rings on opposite sides of the barrier island: the St. Catherines Shell Ring (9LI231) on the west side of the island, and the McQueen Shell Ring (9LI1648), on the east side. These rings are separated by approximately 3 km and are morphologically similar structures: both are closed circles approximately 70 m in diameter (Sanger and Thomas, 2010).

The St. Catherines Shell Ring and the McQueen Shell Rings were excavated by Sanger and Thomas between 2006–2014 (Thomas, 2008; Sanger and Thomas, 2010; Sanger, 2015a; Sanger, 2017a,b). Data from archaeological excavations suggest that people may have been using the rings for ritual activities, such as large-scale ceremonial gatherings. At the McQueen Shell Ring, this is supported by the presence of prestige goods necessitating long-distance exchange, such as Native copper from the Great Lakes (Sanger et al., 2019). Heat-treated lithics and calcined bone, some of which was human, were also identified at McQueen (Sanger and Ogden, 2018). In the direct center of St. Catherines Shell Ring, a cluster of overlapping pits was identified, containing fragmented deer, turtle, fish bone, and some calcined bone (Colaninno and Reitz, 2015; Sanger, 2017b). A flattened, circular ground stone, similar in shape to chunky stone, was also found in the center of St. Catherines Shell Ring.

More than 11,000 lithic artifacts, including 150 stone tools have been recovered from archaeological excavations at the two rings. A large percentage of these were tertiary flakes, suggesting that people were primarily engaged in late-stage reduction and sharpening of stone tools due to limited access to raw stone materials on the coast. Extra-local stone was present, but rare, indicating that people at both rings utilized mainland resources within one- or two-days travel away. McQueen had higher numbers of exotic lithic materials, suggesting

they were engaged in long-distance resource acquisition or had broader exchange networks (Sanger and Ogden, 2018).

More than 50,000 pottery sherds were recovered from the shell rings (Sanger, 2017a). Most were undecorated, fiber-tempered sherds, but detailed ceramic analysis, including radiographic analyses, showed differences in decorative traditions and formation methods between the two shell rings. Baked clay objects, used as boiling stones for indirect heat cooking, were present at the St. Catherines Shell Ring, but not McQueen (Sanger, 2015a). Items of personal adornment, such as bone pins and shell beads were also found at both shell rings (Sanger, 2015a).

People living at both rings shared similar foodways. Eastern oyster is the most common taxon in the shell ring deposits. Hard clams, stout tagelus, sea catfishes, mullets, killifishes, drumfish, diamond back terrapins, and white-tailed deer are also present in midden deposits (Reitz, 2008; Thomas, 2008; Cannarozzi, 2012; Colaninno, 2012b).

Fishing was an important component of Late Archaic subsistence strategies, and people used a diversity of technologies in various habitats to capture fish individually, as well as mass capture techniques (Colaninno, 2022) that would have required shared labor and cooperation (Colaninno, 2011a,b). There are overall similarities in the species type at each ring, with differences likely due to proximity of various fishing areas to each site (Colaninno, 2022). Archaeobotanical studies show that acorns and large numbers of hickory nuts were processed at both rings (Ruhl, 2015) and stored in large pits in the rings' interior (Sanger, 2017b).

Both shell rings were occupied at all seasons of the year. This is evidenced by season of capture data from fishes representing all four seasons found across both sites (Colaninno, 2012a,b, 2022; Sanger et al., 2020). Seasonality data from hard clams and oysters suggest that people were primarily harvesting these resources during the winter/spring seasons (Cannarozzi, 2012; Quitmyer and Jones, 2012; Cannarozzi and Kowalewski, 2019).

The depositional morphology of the shell deposits indicates people constructed the shell rings in different manners, with expansive horizontal deposits at McQueen suggesting purposeful construction while more mounded deposits at St. Catherines could be interpreted as growing more "organically" (Sanger, 2015b). Cross-mended artifact data from the St. Catherines Shell Ring suggests people likely constructed these shell deposits gradually, and periodically in limited areas (Cajigas et al., 2023). The seasonality data from vertebrate remains from these sites support models that interpret shell rings as the result of circular village refuse, accumulating over four seasons of the year (Colaninno, 2022).

Taken as a whole, we believe these data suggest people were using these rings as ceremonial villages (Sanger, 2015a). They were places where at least some portion of the community resided during all four seasons, punctuated by larger gatherings of people during the colder months (Cannarozzi, 2012; Quitmyer and Jones, 2012; Sanger and Ogden, 2018; Sanger et al., 2020).

1.4 A third shell ring: the Musgrove Shell Ring

In 2022, we identified a third shell ring (Figure 1) using recently published LIDAR data (OCM Partners, 2023; 2018–2019 USGS Lidar:

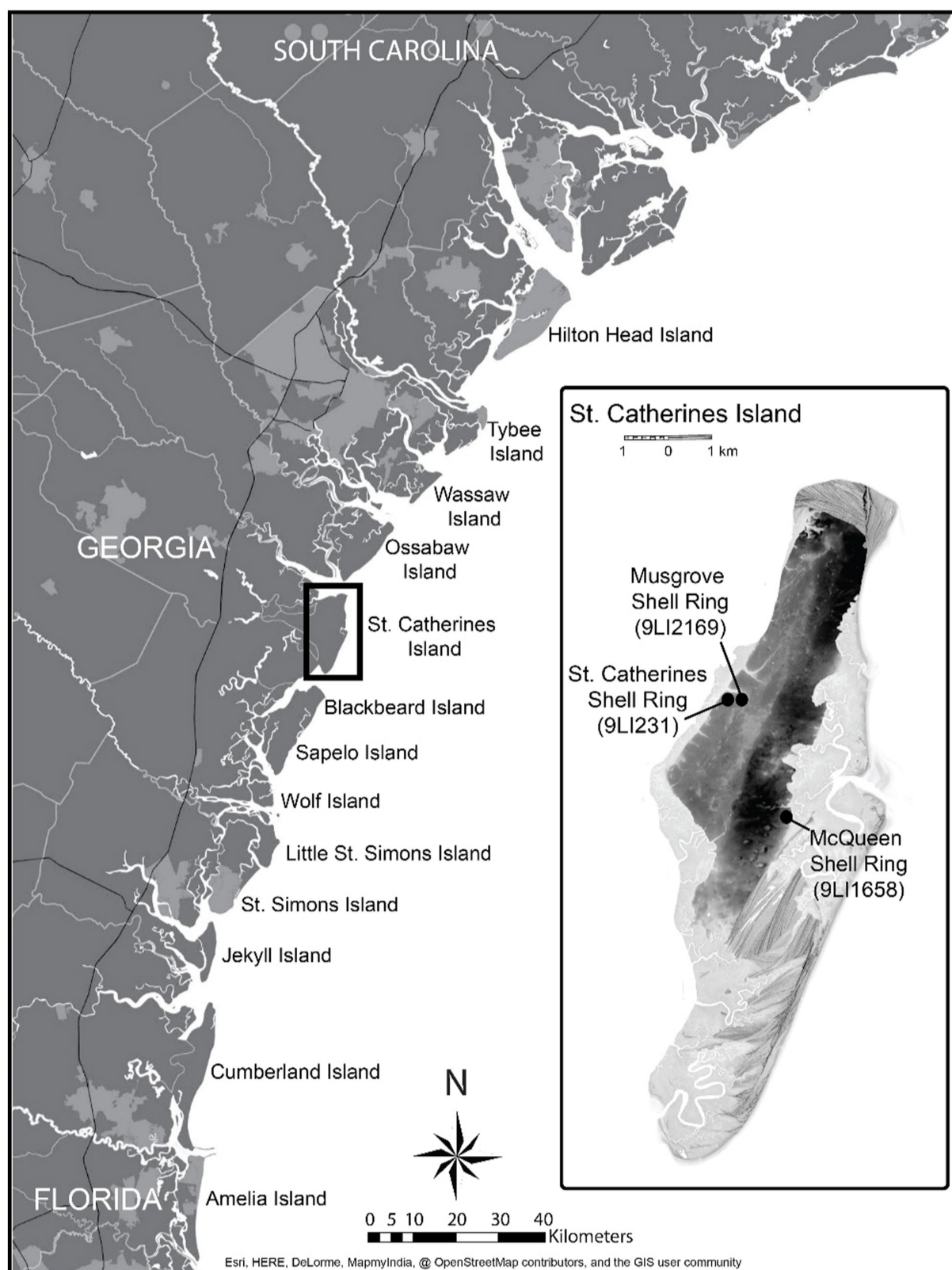


FIGURE 1
Map of the three rings on St. Catherines Island.

GA Statewide, <https://www.fisheries.noaa.gov/inport/item/67264>). This recently identified site, the Musgrove Shell Ring (9LI2169), is located approximately 250 m east of the St. Catherines Shell Ring. This

ring appeared in the LIDAR data as a relatively flat circle, approximately 60 m in diameter, with only approximately 30 cm in relief (Figure 2). The topography of the shell ring is almost

imperceptible in person due to historic plowing, which leveled the ground surface.

Shallow geophysical surveys were conducted to better understand the structure of the shell deposit. Minimally and non-invasive explorations included shell-probe surveys, magnetic gradiometer surveys, electrical resistance tomography, and time domain induced polarization confirm its open-circle, C-shape (Plattner et al., 2023).

One test pit, placed in the southern portion of the shell arc, confirms that unlike McQueen or St. Catherines, the Musgrove Shell Ring is arcuate in shape, with the southern portion free of shell.

We excavated three additional test pits across the shell-bearing portions of the shell arc, attempting to target the thickest shell deposits and test a diverse range of shell ring construction across the site. These limited excavations into the shell-bearing portions of the deposit were conducted primarily to collect radiocarbon samples that represent the full span of shell ring construction.

The shell layer was approximately 50 cm in thickness, although the original shell ring deposit was likely thicker prior to historic plowing. Samples were collected throughout the shell ring profile, including features within the shell, as well as samples underlying the shell deposit. Figure 3 shows the southern profile of Unit N2131 E4186, where six samples from Musgrove Shell Ring were collected for radiocarbon dating.

This unit had three features within the shell deposit that were radiocarbon dated. Features 1 and 2 were likely from the same depositional event and had identical radiocarbon dates. Feature 1 had large amounts of crushed shell and Feature 2 was organic soil with crushed shell and charcoal below Feature 1. This burned, crushed shell feature was approximately 10 cm thick and at least 60 cm in diameter. Feature 7, underlying these two features, consisted of dark, organic soil with some whole and crushed shell inclusions. Radiocarbon samples were also collected from the top and bottom of the shell ring deposit, as well as from the buried A horizon underlying the shell deposit.

Supplementary Table S1 lists the provenience for all samples. The stratigraphy and radiocarbon dating of the St. Catherines and McQueen Shell Rings have been discussed elsewhere (Sanger and Thomas, 2010; Kennett and Culleton, 2012; Sanger, 2015a).

2 Methods and materials

2.1 Radiocarbon dating and Bayesian modeling

Previous radiocarbon research using a summed probability approach indicate that the St. Catherines Shell Ring and the McQueen

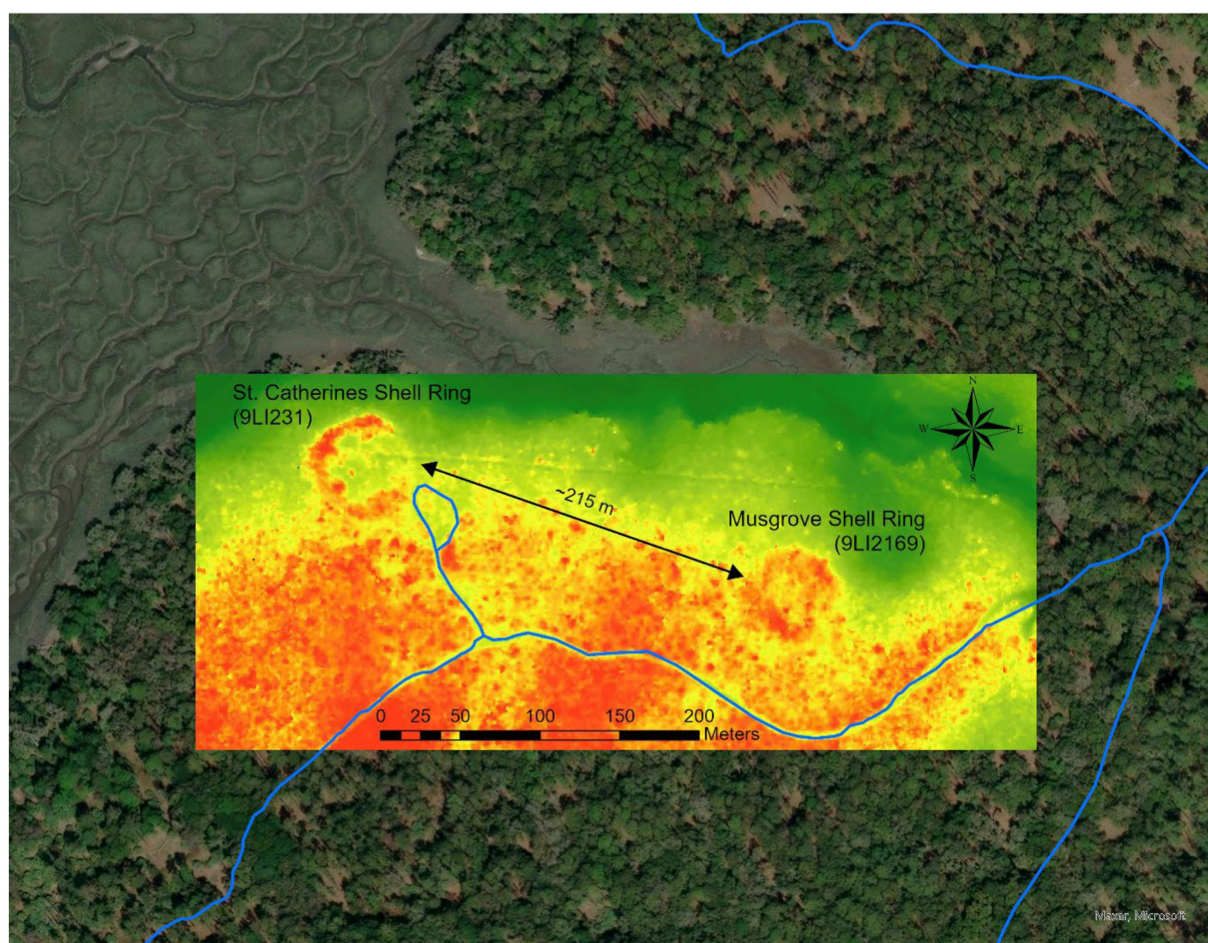


FIGURE 2
Lidar map of St. Catherines and Musgrove Shell Rings.

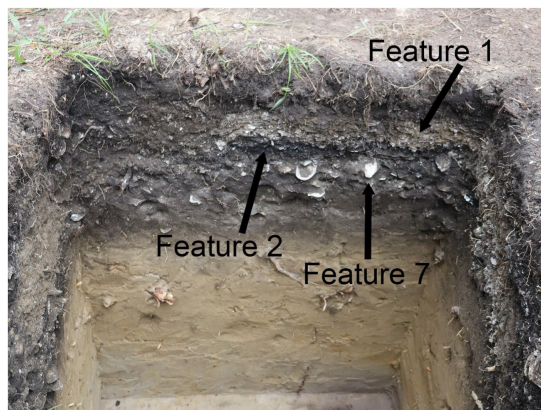


FIGURE 3
Unit N2131 E4186 from Musgrove Shell Ring, facing south. Test unit profile is 1 m across.

Shell Ring and were relatively contemporaneous, with both sites dating to c. 4,200–3,800 cal BP (Sanger and Thomas, 2010: 62–63). These summed probabilities suggest the simultaneous occupation of the sites over a long period of time.

Bayesian modeling allows us to use additional information, such as stratigraphic relationships, to potentially tighten these date ranges and better understand sequential relationships and start and end dates for specific deposits.

Initial Bayesian modeling on terrestrial and marine samples from both rings clarified the temporal relationship further, indicating that shell deposition at the St. Catherines Shell Ring began before the earliest deposits at the McQueen Shell Ring, and that construction and use at McQueen persisted later in time (Kennett and Culleton, 2012). The start of the McQueen Shell Ring deposition was estimated between 2,520 and 2,100 cal BC (4470–4,050 cal BP) which overlaps with dates from ring construction at the St. Catherines Shell Ring beginning at 2430–2200 cal BC (4380–4,150 cal BP). These data suggest an overlap of at least 200 years and indicate they are contemporary.

A higher resolution understanding of shell ring construction and the sequence of these communities is necessary to articulate the Musgrove Shell Ring within this chronological framework, and better understand the diversity of the shell ring communities, as evidenced by their material culture and morphology.

2.2 Sampling and methodology

We analyzed a total of 34 AMS radiocarbon dates on the three shell rings from St. Catherines Island: existing radiocarbon samples from the McQueen Shell Ring ($n = 10$), the St. Catherines Shell Ring ($n = 10$), as well as new radiocarbon dates from the Musgrove Shell Ring ($n = 14$). These dates are also included in our regional study on shell ring chronology (Thompson et al., 2024). Here, our presentation of the chronologies for St. Catherines Island specifically, provide a more detailed examination of how these chronologies are important to our understanding of shell ring villages at the island level. Furthermore, this also allows us to discuss the details of these dates in relation to the artifact

assemblages at these rings, which was not possible in our regional study.

The radiocarbon samples selected for this study were terrestrial samples (bone, carbonized wood, and hickory nut) collected from shell deposits in the shell ring and features in the center of the shell ring. Similar to other subtropical environments in the Southeast U.S. with high temperatures, rainfall, and presence of biological agents of decay (Thompson et al., 2016), we assume decay rates of carbonized wood to be high enough that the “old wood problem” (Schiffer, 1986) will not significantly affect our results.

We chose to exclusively analyze terrestrial materials rather than compare terrestrial and marine samples where some dates would require a marine reservoir correction, which would contribute additional uncertainty to the calibrated date (Hadden et al., 2023). And, the lower-precision, wider calibrated ranges of marine samples can make it difficult to distinguish precise contemporaneity (Kennett and Culleton, 2012). This was one of the key challenges in previous dating studies from St. Catherines Island shell rings (Thomas, 2008; Sanger and Thomas, 2010; Kennett and Culleton, 2012; Sanger, 2015a).

For each of the shell rings, we constructed a series of Bayesian models on samples associated with shell ring deposition. While these models are also included in our larger regional study, here, we analyze them at the local scale, and in greater detail, in order to examine the relationships between St. Catherines Island rings specifically. Readers interested in the regional context of shell rings in the South Atlantic Bight are directed to Thompson et al. (2024).

Specific provenience information from each of the terrestrial radiocarbon samples collected from the three shell rings is published in Supplementary Table S1 (see also Thomas, 2008; Sanger and Thomas, 2010; Sanger, 2015a; Thompson et al., 2024). For this analysis, we used OxCal 4.4.4 (Buck et al., 1991; Bronk Ramsey, 2009) and the IntCal20 14C calibration curve (Reimer et al., 2020). These models are based on the types of samples as well as their contexts and stratigraphic ordering. The use of *a priori* information allowed us to construct models with date ranges that are more constrained than models with only simple calibration alone (Hamilton and Krus, 2017). Most of our models are straightforward simple Phase models which are detailed in the Supplementary Information. The models presented below represent the most likely scenario based on what we know about the archaeology of these shell rings. In particular, we used both a General and Charcoal outlier model for these final models which downweights potential temporal outliers and accounts for some degree of inbuilt age. We also use a log-normal Interval command of 125 years which is based on our assessment of the duration of villages in the Eastern Woodlands, which typically do not exceed 100 to 200 years (see Hally, 2008; Cobb et al., 2015; Barrier, 2017; Manning and Birch, 2022). This constrains the site duration to 250 years which we previously argue is a conservative estimate for these sites (see Thompson et al., 2024 for a more detailed justification). We also used the KDE Plot command to provide a date range for the occupied ring, which we then used to compare using the Order command to return probability estimates for the order of these sites.

3 Results

All modeled dates are reported in italics and the structure of the models can be observed from the bracketed structure of the probability

distribution plots (Figures 4–7) in addition to the runfiles provided in the Supplementary materials.

3.1 St. Catherines Shell Ring

The modeled dates from the St. Catherines Shell Ring use samples collected from the shell deposit of the shell ring and include a sequence of samples in stratigraphic order.

The model (Supplementary Table S13) places the samples into one Phase and includes an ordered Sequence. A General Outlier model was applied to all the dates, and a Date command was applied to estimate the duration of the occupation of the site (see Supplemental Information for additional details and models). For models to be considered in OxCal to indicate good agreement between dates and the stipulated parameters, the Amodel agreement must exceed 60 (Bronk Ramsey, 1995). The Amodel (101.5) exceeds the value for good agreement and represents the best approximation of the dated contexts. The model did not identify any dating outliers.

The model shows that the start date of shell ring construction is 4,380–4,170 cal BP (95.4 hpd) and the end date is 4,230–4,060 cal BP (95.4 hpd) (Table 1). The KDE estimate range for the Phase is 4,310–4,110 cal BP (95.4 hpd) and the Interval of occupation is 10–280 years (95.3 hpd).

3.2 McQueen Shell Ring

The samples analyzed in this model are from shell-bearing units and features in the shell ring deposit. The order of the dates within each Sequence is the stratigraphic order of the samples. As with the St.

Catherines Shell Ring model, a General Outlier model and a KDE command were applied (Supplementary Table S19). The Amodel (113.1) exceeds the value to indicate good agreement between the date and model and represents the best approximation of the dated contexts. The model did not identify any dating outliers.

The start date of construction is 4,140–3,990 cal BP (95.4 hpd) and the end date is 4,050–3,880 cal BP (95.4 hpd) (Table 1). The KDE estimate for the Phase is 4,090–3,930 cal BP (95.4 hpd) and the Interval of occupation is 20–230 years (95.3 hpd).

3.3 Musgrove Shell Ring

This model includes samples from levels associated shell deposition as well as samples from pre-ring deposits underlying the shell. There are several ordered sequences in this model, and a General Outlier model and a Date command were applied (Supplementary Table S7). The Amodel (100.5) exceeds the value for good agreement and represents the best approximation of the dated contexts. The model identified no outliers.

The start date is 4,350–4,160 cal BP (95.4 hpd) and the end date is 4,240–4,110 cal BP (95.4 hpd) (Table 1). The KDE estimate for the Phase is 4,290–4,140 cal BP (95.4 hpd) and the Interval of occupation is 0–190 years (95.3 hpd).

3.4 Comparison of the three shell rings

The summary table of the KDE Phase modeled dates from the three rings (Table 1) show there is significant overlap between the dates from the St. Catherines Shell Ring and the Musgrove Shell Ring.

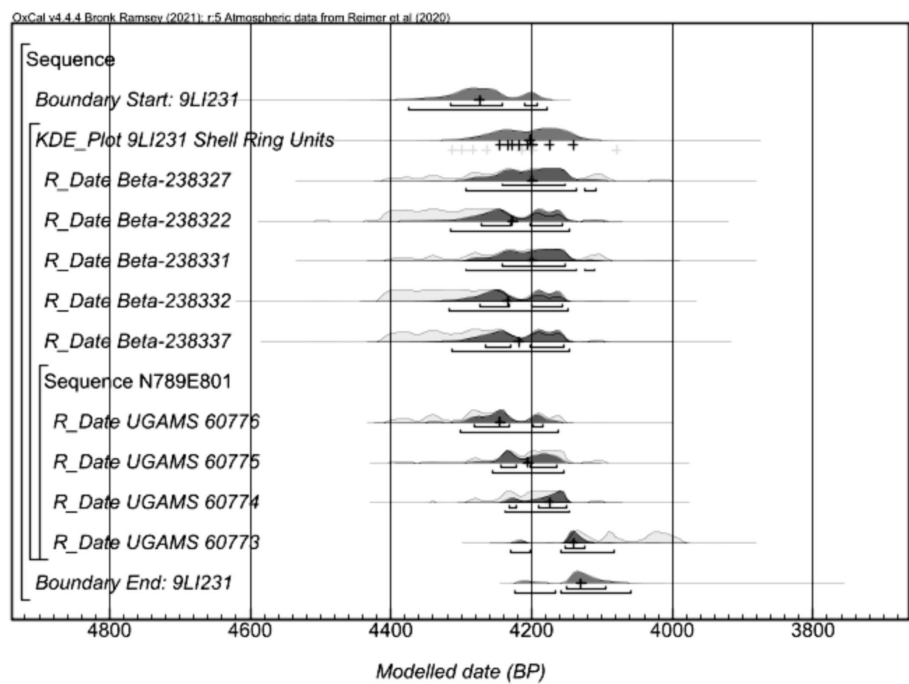


FIGURE 4 Modeled dates from St. Catherines Shell Ring.

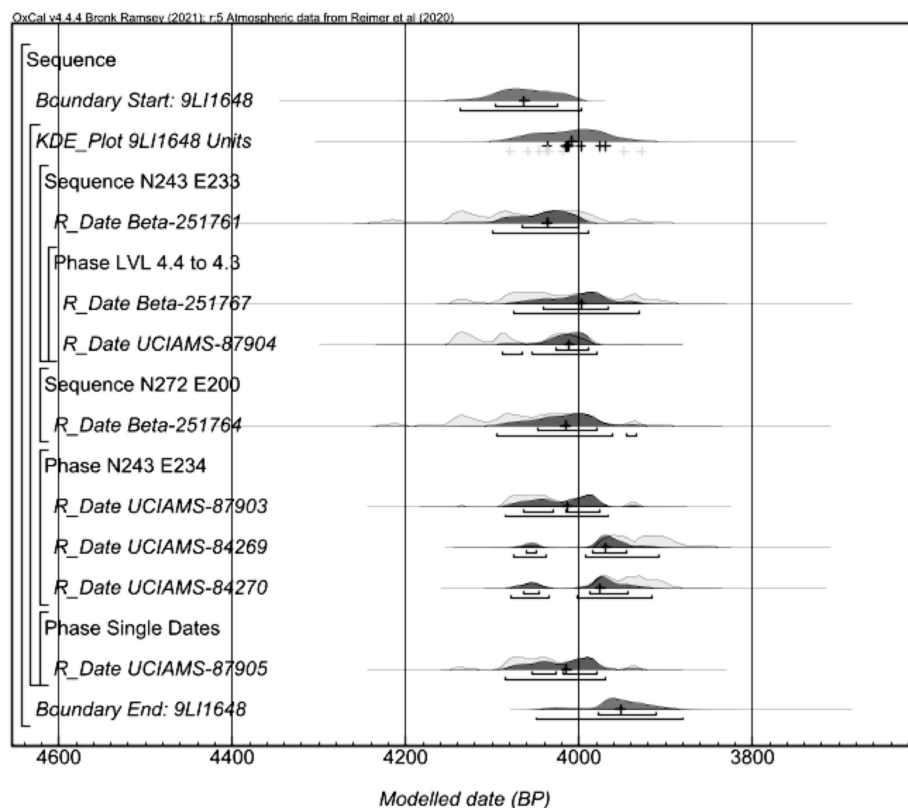


FIGURE 5
Modeled dates from McQueen Shell Ring.

At the Musgrove Shell Ring, the date estimate for the Phase is 4,290–4,140 *cal. BP* (95.4 hpd), which is contemporaneous with the St. Catherine's Shell Ring at 4310–4110 *cal BP* (95.4 hpd). The McQueen Shell Ring postdates both shell rings with Phase dates of 4,090–3,930 *cal BP* (95.4 hpd).

To further clarify this relationship, the KDE estimate of each site occupation from the models were placed in a single phase with the Order command. We took the posterior probability for the duration of each of the rings to assess the chronological relationship between each of the rings. Table 2 presents the probabilities of these relationships. Based on this analysis, there is a high probability that the McQueen Shell Ring post-dates the St. Catherine's Shell Ring and the Musgrove Shell Ring (>99%, both), and the St. Catherine's Shell Ring and the Musgrove Shell Ring are contemporaneous.

4 Discussion

Previous radiocarbon analyses of the Late Archaic on St. Catherine's Island, which included dates derived from archaeological shell, suggest that the St. Catherine's Shell Ring and the McQueen Shell Ring were contemporaneous (Sanger and Thomas, 2010; Kennett and Culleton, 2012; Sanger, 2015a). While this work was a first step in putting these shell rings' temporalities into more detailed focus, our new modeling of dates entirely obtained from terrestrial samples help refine our previous interpretations of the two communities of shell-ring inhabitants on each side of the island.

These results are consistent with previous assertions that the shell arcs accumulated over several decades to a full century after an earlier use of the site (Kennett and Culleton, 2012; Sanger, 2015a). And, according to this new research, although their morphologies differ, the temporality of accumulation of shell was roughly similar for each of the three shell rings.

This research shows that the McQueen Shell Ring post-dates the St. Catherine's Shell Ring, which allows us to enhance our interpretations of the material culture from each site. These differences in the manufacture and decorative traditions of fiber-tempered pottery, lithic material sources, cooking technology, and construction practices between the rings, which researchers previously interpreted as being the result of contemporaneous communities with different practices of lithic procurement, food preparation, and technology, we attribute instead to communities transformed by time.

Specifically, there are key differences among these communities that link into larger processes. First, St. Catherine's and Musgrove are among the earliest rings in the region that also have evidence of pottery production (Thompson et al., 2024). The chronology data and the proximity of the St. Catherine's Shell Ring and the Musgrove Shell Ring indicate that the people living at these sites were co-residents. And, the large amount of plain pottery sherds and baked clay objects from St. Catherine's demonstrate that inhabitants were on the forefront of pottery production in the region (see Sanger, 2016). As Sanger (2016:595–596) notes the most common method of pottery construction at St. Catherine's Shell Ring is “dual-fold slab building, which is relatively rare at McQueen,” where there

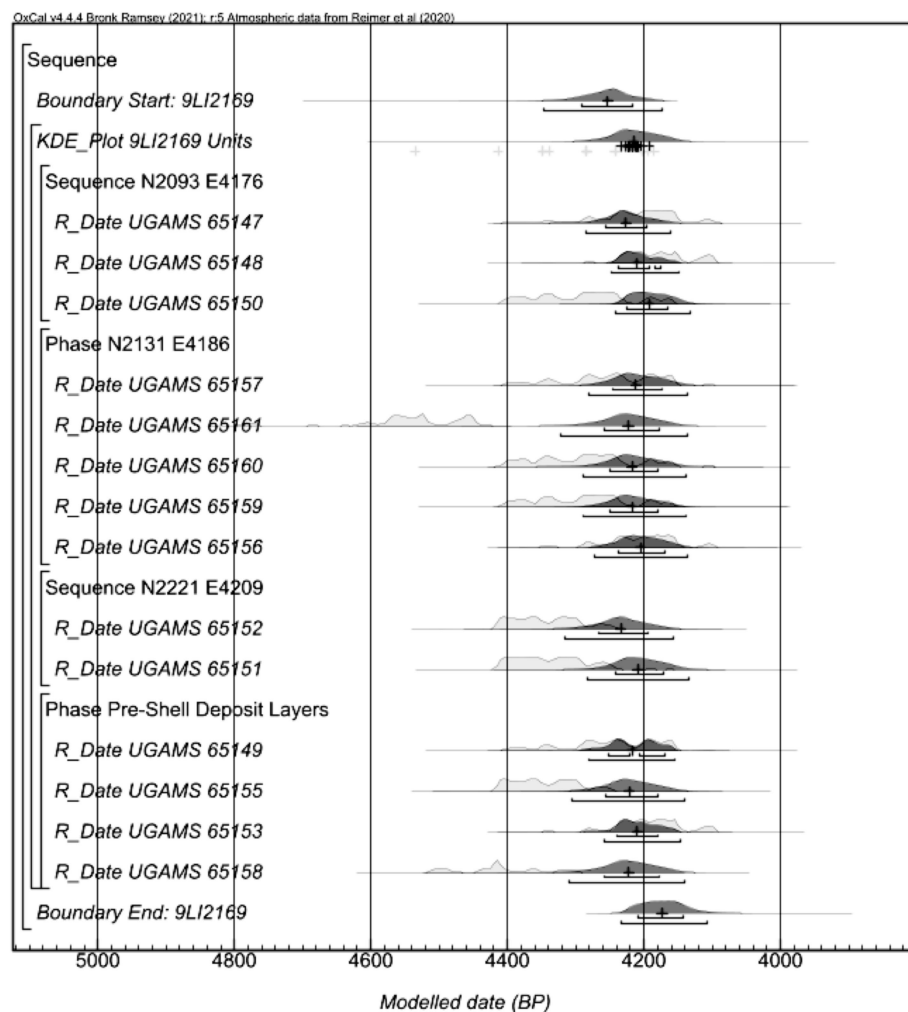


FIGURE 6
Modeled dates from Musgrove Shell Ring.

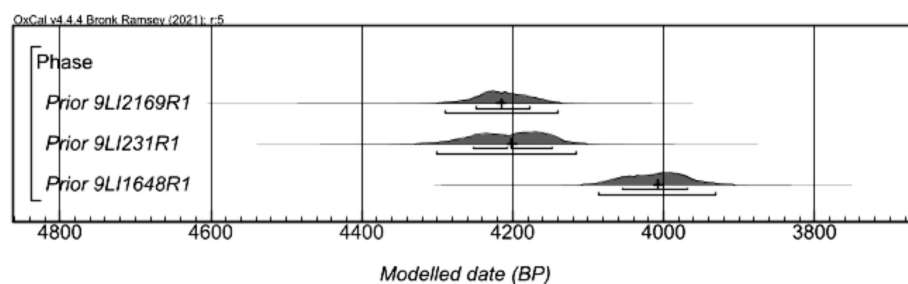


FIGURE 7
KDE modeled dates from the three rings.

was a greater prevalence of “homogenous slab-building.” Further, the later McQueen Ring not only has more diverse pottery production techniques, there is also an absence of baked clay objects and a significantly higher frequency of decorated pottery. Finally, the sheer quantity of pottery sherds (> 40,000) indicate that pottery production and experimentation was in full swing by the

time the McQueen Shell Ring community inhabited the island. Thus, in terms of settling down, the duration of more permanent villages on the landscape likely had an overarching influence on technological changes within these communities. While such detailed studies of material culture for the Musgrove Shell Ring are ongoing, future research within this new understanding of how

TABLE 1 Summary table of modeled dates for the three shell rings.

Name	Unmodelled (BP)			Modelled (BP)			to_95_4	from_95_4	to_95_4	A	C
	median	from_68_3	to_68_3	median	from_68_3	to_68_3					
Prior 9LI2169R1	4,220	4,250	4,170	4,220	4,250	4,170	4,140	4,290	4,140	100.6	95.9
Prior 9LI231R1	4,200	4,260	4,140	4,200	4,260	4,140	4,110	4,310	4,110	99.8	96.1
Prior 9LI1648R1	4,010	4,060	3,960	4,010	4,060	3,960	3,930	4,090	3,930	100.4	96

TABLE 2 Probability of chronological relationships between the shell rings.

Order	9LI2169R1	9LI231R1	9LI1648R1
9LI2169R1	0	0.5644	0.9998
9LI231R1	0.4356	0	0.9994
9LI1648R1	0.000167	0.000583	0

cultural traditions at shell rings on St. Catherines Island have transformed over time will allow archaeologists to test models and assumptions regarding these broader patterns of material culture and community organization.

Furthermore, this iterative research in radiocarbon using Bayesian modeling is key in refining the timing of construction and abandonment, helping us to securely articulate the timing of site use with environmental change, including sea-level change. Because this research more precisely defines the phase of occupation at the shell ring sites rather than changing the previously accepted date ranges for the shell rings, the results lend further support to previous hypotheses about shell ring abandonments correlating to a drop in sea-levels after 4,200 cal BP, culminating in the abandonment of shell ring villages by 3,800 cal BP along the Georgia Coast (Gayes et al., 1992; Turck and Thompson, 2016). The proximity of the Musgrove Shell Ring to the St. Catherines Shell Ring, as well as the similarity in elevation and landscape, further supports the idea that this wave of shell ring abandonments occurring at this time is, in fact, correlated to elevation above sea-level and proximity to marsh resources (Sanger, 2010).

Previous research on the shell ring communities at St. Catherines Island suggest Late Archaic people on the coast adopted a complex settlement strategy, where groups aggregated at villages for large-scale gatherings during the winter (Sanger and Ogden, 2018; Sanger et al., 2020). Refining this chronology and connecting it to data from the material culture at these different villages will allow us to test this seasonal model at a solidly contemporaneous village.

This case study highlights the importance of high precision temporal analysis of shell rings and can tell us more about the timing of people living in these persistent and contemporary communities and shows the diversity of sedentary models among pre-agricultural communities on the coast. Specifically, this work highlights the fact that the process of settling down is more complicated and involved than simply the emergence of villages. In the case of St. Catherines Island, multiple communities (i.e., the St. Catherines and Musgrove rings) both inhabited the island at the same time and subsequently reinhabited the island later (the McQueen ring). In each of these instances, shell ring inhabitants would have had to negotiate different social and ecological landscapes for village life to continue to be viable. Understanding the timing of these communities is thus critical to begin to explore the attendant challenges that these earliest settled communities faced on both short- and long-term time scales.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

RC: Writing – original draft, Writing – review & editing. MS: Writing – original draft. AS: Writing – original draft. VT: Writing – original draft. CG: Writing – original draft. EB: Writing – original draft. DT: Writing – original draft.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This research was supported, in part, in association with the Georgia Coastal Ecosystems LTER project and by National Science Foundation grants awarded to Thompson and Sanger (NSF Grants OCE-0620959, OCE-123714, NSF-1748276), the Edward John Noble Foundation, the St. Catherines Island Foundation, and the University of Alabama. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Acknowledgments

The Edward John Noble and St. Catherines Island Foundations, the St. Catherines Island staff, the 2023 University of Alabama Archaeological Field School students, and the St. Catherines Island Archaeology crew, including Lorann Pendleton, Thomas Blaber, Abigail Musch, Caitria O'Shaughnessy, and Diana Rosenthal

References

- Andrus, C. F. T., and Thompson, V. D. (2012). Determining the habitats of mollusk collection at the Sapelo Island shell ring complex, Georgia, USA using oxygen isotope sclerochronology. *J. Archaeol. Sci.* 39, 215–228. doi: 10.1016/j.jas.2011.08.002
- Barrier, C. R. (2017). Town aggregation and abandonment during the era of urban transformations in the Cahokia region: Bayesian modeling of the Washausen mound-town. *J. Archaeol. Sci. Rep.* 11, 523–535. doi: 10.1016/j.jasrep.2016.12.027
- Bronk Ramsey, C. (1995). Radiocarbon calibration and analysis of stratigraphy: the OxCal program. *Radiocarbon* 37, 425–430. doi: 10.1017/S0033822200030903
- Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. *Radiocarbon* 51, 337–360. doi: 10.1017/S0033822200033865
- Buck, C. E., Kenworthy, J. B., Litton, C. D., and Smith, A. F. (1991). Combining archaeological and radiocarbon information: a Bayesian approach to calibration. *Antiquity* 65, 808–821. doi: 10.1017/S0003598X00080534
- Cajigas, R., Sanger, M. C., and Thompson, V. D. (2023). Cross-mended ceramic sherds as a proxy for depositional processes at two late archaic shell rings in coastal Georgia. *Southeast. Archaeol.* 42, 178–193. doi: 10.1080/0734578x.2023.2213544
- Cannarozzi, N. R. (2012). "Estimating the season of harvest of the eastern oyster (*Crassostrea virginica*) from the St. Catherines Shell ring" in *Seasonality and human mobility along the Georgia Bight*. eds. E. J. Reitz, I. R. Quitmyer and D. H. Thomas, vol. 97 (New York: Anthropological Papers of the American Museum of Natural History), 171–185.
- Cannarozzi, N. R., and Kowalewski, M. (2019). Seasonal oyster harvesting recorded in a late archaic period shell ring. *PLoS One* 14:e0224666. doi: 10.1371/journal.pone.0224666
- Cobb, C. R., Krus, A. M., and Steadman, D. W. (2015). Bayesian modeling of the occupation span of the Averbuch site in the middle Cumberland drainage, Tennessee. *Southeast. Archaeol.* 34, 46–56. doi: 10.1179/2168472314Y.00000000005
- Colaninno, C. E. (2011a). *Zooarchaeological analysis of vertebrate remains from five late archaic shell rings on the Georgia coast, USA*. Dissertation. Athens (GA): University of Georgia.
- Colaninno, C. E. (2011b). Examining ichthyofaunal remains for evidence of fishing technologies employed in Georgia estuaries during the late archaic period. *Southeast. Archaeol.* 30, 337–350. doi: 10.1179/sea.2011.30.2.008
- Colaninno, C. E. (2012a). "Evaluating $\delta^{18}\text{O}$ profiles of hardhead catfish and Atlantic croaker otoliths as a method of determining seasonal use of fishes" in *Seasonality and human mobility along the Georgia Bight*. eds. E. J. Reitz, I. R. Quitmyer and D. H. Thomas, vol. 97 (New York: Anthropological Papers of the American Museum of Natural History), 83–101.
- Colaninno, C. E. (2012b). Evaluating formational models for late archaic Shell rings of the southeastern United States using vertebrate Fauna from the St. Catherines Shell ring, St. Catherines Island, Georgia. *J. Island Coast. Archaeol.* 7, 338–362. doi: 10.1080/15564894.2012.708008
- Colaninno, C. E. (2022). Foodways of the late archaic people of St. Catherines Island, Georgia: an analysis of vertebrate remains from two shell rings. *Southeast. Archaeol.* 41, 183–199. doi: 10.1080/0734578x.2022.2099042
- Colaninno, C. E., and Compton, J. M. (2018). Integrating vertebrate and invertebrate season of capture data from ring III of the Sapelo Island Shell ring complex (9MC23), Georgia, USA. *J. Isl. Coast. Archaeol.* 14, 560–583. doi: 10.1080/15564894.2018.1458763
- Colaninno, C. E., and Reitz, E. J. (2015). *Animal remains from two late archaic Shell rings on St. Catherines Island, Georgia*. Manuscript on file, Georgia Museum of Natural History, University of Georgia, Athens.
- DePratter, C. B., and Thompson, V. D. (2013). "Past shorelines of the Georgia coast" in *Life among the tides: Recent archaeology on the Georgia Bight*. eds. V. D. Thompson and D. H. Thomas, vol. 98 (New York, NY: Anthropological papers of the American Museum of Natural History), 145–167.
- Garland, C. J., and Thompson, V. D. (2023). Collective action and shellfish harvesting practices among late archaic villagers of the South Atlantic Bight. *J. Anthropol. Archaeol.* 69:101483. doi: 10.1016/j.jaa.2022.101483
- Garland, C. J., Thompson, V. D., Sanger, M. C., Smith, K. Y., Andrus, F. T., Lawres, N. R., et al. (2022). A multi-proxy assessment of the impact of environmental instability on late Holocene (4500–3800 BP) native American villages of the Georgia coast, USA. *PLoS one* 17:e0258979. doi: 10.1371/journal.pone.0258979
- Gayes, P. T., Scott, D. B., Collins, E. S., and Nelson, D. D. (1992). "Late holocene sea-level fluctuation in south carolina" in *Quaternary Coasts of the United States: Marine and Lacustrine Systems*, SEPM Society for Sedimentary Geology Special Publication No. 48. eds. C. H. Fletcher and J. F. Wehmiller (Tulsa: Society for Sedimentary Geology), 155–160. doi: 10.1007/978-94-007-4026-6-4
- Hadden, C. S., Hutchinson, I., and Martindale, A. (2023). Dating marine Shell: a guide for the wary north American archaeologist. *Am. Antiq.* 88, 62–78. doi: 10.1017/aaq.2022.82

Roberson. We also thank two reviewers for their comments which improved this manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fhumd.2024.1358614/full#supplementary-material>

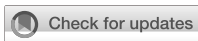
- Hally, D. (2008) *King: The social archaeology of a late Mississippian town in northwestern Georgia*. (Tuscaloosa: University of Alabama Press).
- Hamilton, W. D., and Krus, A. M. (2017). The myths and realities of Bayesian chronological modeling revealed. *Am. Antiq.* 83, 1–17. doi: 10.1017/aaq.2017.57
- Kennett, D., and Culleton, B. J. (2012). “A Bayesian chronological framework for determining site seasonality and contemporaneity” in *Seasonality and human mobility along the Georgia Bight*. eds. E. J. Reitz, I. R. Quitmyer and D. H. Thomas, vol. 97 (New York: Anthropological Papers of the American Museum of Natural History), 37–50.
- Mahar, G. J. (2013). “Archaeological geophysics on St. Catherines Island: beyond prospection” in *Life among the tides: Recent archaeology on the Georgia Bight*. eds. V. D. Thompson and D. H. Thomas, vol. 98 (New York: Anthropological Papers of the American Museum of Natural History), 75–93.
- Manning, S. W., and Birch, J. A. (2022). Centennial ambiguity: the challenge of resolving the date of the Jean-Baptiste Lainé (mantle), Ontario, site—around AD 1500 or AD 1600?—and the case for wood-charcoal as a terminus post quem. *Radiocarbon* 64, 279–308. doi: 10.1017/RDC.2022.23
- Marrinan, R. A. (2010). “Two late archaic period Shell rings, St. Simon’s island, Georgia.” In *Trend, tradition, and turmoil: What happened to the southeastern archaic?*, edited by D. H. Thomas and M. C. Sanger, 71–102. New York, NY: American Museum of Natural History Anthropological Papers 93.
- Partners, O. C. M. (2023). 2018–2019 USGS Lidar: GA statewide from 2010-06-15 to 2010-08-15 NOAA National Centers for Environmental Information Available at: <https://www.fisheries.noaa.gov/inport/item/67264>.
- Plattner, A., Blair, E., Semon, A. M., Cajigas, R., Blaber, T., Sanger, M. C., et al. (2023). “Geophysical investigation of a ~45000 year old native American Shell ring” in *Presentation in advances in geophysical methods for archaeology, forensic and anthropological targets at the American Geophysical union fall meeting, December 11–15, 2023* (San Francisco, CA: American Geophysical Union).
- Quitmyer, I. R., and Jones, D. S. (2012). “Annual incremental Shell growth patterns in hard clams (*Mercenaria* spp.) from St. Catherines Island, Georgia: a record of seasonal and Anthropogenic impact on Zooarchaeological resources” in *Seasonality and human mobility along the Georgia Bight*. eds. E. J. Reitz, I. R. Quitmyer and D. H. Thomas (New York: Anthropological Papers of the American Museum of Natural History), 135–148.
- Quitmyer, I. R., Jones, D. S., and Arnold, W. S. (1997). The sclerochronology of hard clams, *mercenariasp.*, from the South-Eastern USA: a method of elucidating the zooarchaeological records of seasonal resource procurement and seasonality in prehistoric shell middens. *J. Archaeol. Sci.* 24, 825–840. doi: 10.1006/jasc.1996.0163
- Reimer, P., Austin, W. E. N., Bard, E., Bayliss, A., Blackwell, P., Ramsey, C. B., et al. (2020). The Int Cal 20 northern hemisphere radiocarbon age calibration curve (0–55 kcal BP). *Radiocarbon* 62, 725–757. doi: 10.1017/RDC.2020.41
- Reitz, E. J. (2008). “Nonhuman Vertebrate Remains” in *Native American landscapes of St. Catherines Island, Georgia*. ed. D. H. Thomas, vol. 88 (New York: Anthropological Papers of the American Museum of Natural History), 615–665.
- Reitz, E. J. (2014). Continuity and resilience in the Central Georgia Bight (USA) fishery between 2760 BC and AD 1580. *J. Archaeol. Sci.* 41, 716–731. doi: 10.1016/j.jas.2013.10.004
- Reitz, E. J., Colaninno, C. E., Quitmyer, I. R., and Cannarozzi, N. R. (2022). A 4,000-year record of multifaceted fisheries in the Central Georgia Bight (USA). *Southeast. Archaeol.* 41, 253–270. doi: 10.1080/0734578x.2022.2134084
- Ruhl, D. L. (2015) *Plant husbandry practices revealed at two “sister” archaic period Shell ring sites on St. Catherines Island, Georgia*. Manuscript on file, division of anthropology, American Museum of Natural History. New York.
- Russo, M. (1991) “Archaic Sedentism on the Florida coast: A case study from Horr’s island.” PhD. dissertation, Gainesville: Department of Anthropology, University of Florida, Gainesville.
- Russo, M. (2004). “Measuring Shell rings for social inequality” in *Signs of power: The rise of cultural complexity in the southeast*. eds. J. L. Gibson and P. J. Carr (Tuscaloosa: The University of Alabama Press), 26–70.
- Russo, M. (2006). “Archaic Shell rings of the southeast U.S.” in *National historic landmarks historic context* (Tallahassee: Southeast Archaeological Center, National Park Service)
- Russo, M. (2014). “Ringed Shell features of the southeastern United States” in *The cultural dynamics of Shell-matrix sites*. eds. M. Roksandic, S. Mendonça de Souza, S. Eggers, M. Burchell and D. Klokler (Albuquerque: University of New Mexico Press), 21–39.
- Russo, M., and Heide, G. (2001). Shell rings of the southeast US. *Antiquity* 75, 491–492. doi: 10.1017/S0003598X00088591
- Sanger, M. C. (2010). “Leaving the rings: Shell ring abandonment and the end of the late archaic” in *Trend, tradition, and turmoil: What happened to the southeastern archaic?* eds. D. H. Thomas and M. C. Sanger, vol. 93 (New York, NY: American Museum of Natural History Anthropological Papers), 201–215.
- Sanger, M. C. (2015a). *Life in the round: Shell rings of the Georgia Bight*. Ph. D. Dissertation New York, NY: Columbia University.
- Sanger, M. C. (2015b). Determining depositional events within shell deposits using computer vision and photogrammetry. *J. Archaeol. Sci.* 53, 482–491. doi: 10.1016/j.jas.2014.10.026
- Sanger, M. C. (2016). Investigating pottery vessel manufacturing techniques using radiographic imaging and computed tomography: studies from the late archaic american southeast. *J. Archaeol. Sci.* 9, 586–598.
- Sanger, M. C. (2017a). Coils, slabs, and molds: examining community affiliation between late archaic shell ring communities using radiographic imagery of pottery. *Southeast. Archaeol.* 36, 95–109. doi: 10.1080/0734578X.2016.1267466
- Sanger, M. C. (2017b). Evidence for significant subterranean storage at two hunter-gatherer sites: the presence of a mast-based economy in the late archaic coastal American southeast. *Am. Antiq.* 82, 50–70. doi: 10.1017/aaq.2016.6
- Sanger, M. C., and Ogden, Q.-M. (2018). Determining the use of late archaic shell rings using lithic data: “ceremonial villages” and the importance of stone. *Southeast. Archaeol.* 37, 232–252. doi: 10.1080/0734578X.2017.1398995
- Sanger, M. C., Padgett, B. D., Larsen, C. S., Hill, M., Lattanzi, G. D., Colaninno, C. E., et al. (2019). Great Lakes copper and shared mortuary practices on the Atlantic Coast: implications for long-distance exchange during the late archaic. *Am. Antiq.* 84, 591–609. doi: 10.1017/aaq.2019.59
- Sanger, M. C., Quitmyer, I. R., Colaninno, C. E., Cannarozzi, N., and Ruhl, D. L. (2020). Multiple-proxy seasonality indicators: an integrative approach to assess Shell Midden formations from late archaic Shell rings in the coastal Southeast North America. *J. Isl. Coast. Archaeol.* 15, 333–363. doi: 10.1080/15564894.2019.1614116
- Sanger, M. C., and Thomas, D. H. (2010). “The two rings of St. Catherines Island: some preliminary results from the St. Catherines and McQueen Shell ring” in *Trend, tradition, and turmoil: What happened to the southeastern archaic?* eds. D. H. Thomas and M. C. Sanger, vol. 93 (New York, NY: American Museum of Natural History Anthropological Papers), 45–69.
- Saunders, R. (2002). “The Fig Island ring complex (38CH42): Coastal adaptation and the question of ring function in the late archaic,” (Columbia, SC: South Carolina Department of Archives and History).
- Saunders, R. (2004). The stratigraphic sequence at Rollins Shell ring: implications for ring function. *Fla. Anthropol.* 57, 249–268.
- Saunders, R. (2014). “Shell rings of the lower Atlantic coast of the United States” in *The cultural dynamics of Shell-matrix sites*. eds. M. Roksandic, S. Mendonça de Souza, S. Eggers, M. Burchell and D. Klokler (Albuquerque: University of New Mexico Press), 41–55.
- Saunders, R., and Russo, M. (2011). Coastal shell middens in Florida: a view from the archaic period. *Quat. Int.* 239, 38–50. doi: 10.1016/j.quaint.2010.08.008
- Schiffer, M. B. (1986). Radiocarbon dating and the “old wood” problem: the case of the Hohokam chronology. *J. Archaeol. Sci.* 13, 13–30. doi: 10.1016/0305-4403(86)90024-5
- Thomas, D. H. (2008). *Native American landscapes of St. Catherines Island, Georgia*. New York: American Museum of Natural History, 88.
- Thomas, D. H. (2014). The shellfishers of St. Catherines Island: hardscrabble foragers or farming beachcombers? *J. Isl. Coast. Archaeol.* 9, 169–182. doi: 10.1080/15564894.2013.840874
- Thomas, D. H., Kick, M., Sanger, M. C., and Semon, A. M. (2008). “Terrestrial foraging on St. Catherines Island” in *Native American landscapes of St. Catherines Island, Georgia*. ed. D. H. Thomas, vol. 88 (New York: Anthropological Papers of the American Museum of Natural History), 136–197.
- Thompson, V. D. (2007). Articulating activity areas and formation processes at the Sapelo Island Shell ring complex. *Southeast. Archaeol.* 26, 91–107.
- Thompson, V. D. (2018). “Collective action and village life during the late archaic on the Georgia coast” in *The archaeology of villages in eastern North America*. eds. J. Birch and V. D. Thompson (Gainesville: University Press of Florida), 20–35.
- Thompson, V. D. (2022). Considering ideas of collective action, institutions, and “hunter-gatherers” in the American southeast. *J. Archaeol. Res.* 31, 503–560. doi: 10.1007/s10814-022-09179-3
- Thompson, V. D., and Andrus, C. F. T. (2011). Evaluating mobility, monumentality, and feasting at the Sapelo Island Shell ring complex. *Am. Antiq.* 76, 315–343. doi: 10.7183/0002-7316.76.2.315
- Thompson, V. D., Marquardt, W. H., Cherkinsky, A., Roberts Thompson, A. D., Walker, K. J., Newsom, L. A., et al. (2016). From shell midden to midden-mound: the geoarchaeology of mound key, an anthropogenic island in Southwest Florida, USA. *PLoS one* 11:e0154611. doi: 10.1371/journal.pone.0154611
- Thompson, V. D., Reynolds, M. D., Haley, B., Jefferies, R., Johnson, J. K., and Humphries, L. (2004). The Sapelo shell ring complex: shallow geophysics on a Georgia Sea island. *Southeast. Archaeol.* 23, 192–201.
- Thompson, V. D., Rick, T., Garland, C. J., Thomas, D. H., Smith, K. Y., Bergh, S., et al. (2020). Ecosystem stability and native American oyster harvesting along the Atlantic Coast of the United States. *Sci. Adv.* 6:eaba9652. doi: 10.1126/sciadv.aba9652
- Thompson, V. D., Smith, K. Y., Sanger, M., Garland, C. J., Pluckhahn, T. J., Napora, K., et al. (2024). Understanding the dynamics of village life along the South Atlantic Coast (ca. 5000 to 3000 years BP). *Sci. Rep.* 14:4691. doi: 10.1038/s41598-024-55047-z
- Thompson, V. D., and Turck, J. A. (2009). Adaptive cycles of coastal hunter-gatherers. *Am. Antiq.* 74, 255–278. doi: 10.1017/S0002731600048599
- Thompson, V. D., and Worth, J. E. (2011). Dwellers by the sea: native American adaptations along the southern coasts of eastern North America. *J. Archaeol. Res.* 19, 51–101. doi: 10.1007/s10814-010-9043-9

Trinkley, M. B. (1985). "The form and function of South Carolina's early woodland Shell rings" in *Structure and process in southeastern archaeology*. eds. R. S. Dickens and H. T. Ward (Tuscaloosa: University of Alabama Press), 102–118.

Turck, J. A., and Alexander, C. R. (2013). "Coastal landscapes and their relationship to human settlement on the Georgia coast" in *Life among the tides: Recent archaeology*

on the Georgia. eds. V. D. T. Bight and D. H. Thomas, vol. 98 (New York: Anthropological papers of the American Museum of Natural History), 169–189.

Turck, J. A., and Thompson, V. D. (2016). Revisiting the resilience of late archaic hunter-gatherers along the Georgia coast. *J. Anthropol. Archaeol.* 43, 39–55. doi: 10.1016/j.jaa.2016.05.006



OPEN ACCESS

EDITED BY

Victor D. Thompson,
University of Georgia, United States

REVIEWED BY

Carey James Garland,
University of Georgia, United States
Isabelle Holland-Lulewicz,
The Pennsylvania State University (PSU),
United States

*CORRESPONDENCE

Jessica A. Jenkins
✉ jjenkins@flagler.edu

RECEIVED 22 December 2023

ACCEPTED 21 March 2024

PUBLISHED 05 April 2024

CITATION

Jenkins JA and Gallivan MD (2024) The oyster revolution: shell middens, shell temper, and settling down in North America's Chesapeake region.

Front. Hum. Dyn. 6:1360290.

doi: 10.3389/fhumd.2024.1360290

COPYRIGHT

© 2024 Jenkins and Gallivan. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

The oyster revolution: shell middens, shell temper, and settling down in North America's Chesapeake region

Jessica A. Jenkins^{1*} and Martin D. Gallivan²

¹Department of Humanities, Flagler College, St. Augustine, FL, United States, ²Department of Anthropology, College of William & Mary, Williamsburg, VA, United States

Transformative social change occurred in the Chesapeake region with the intensification of oyster harvesting and the establishment of central places in estuarine settings at the outset of the Middle Woodland period (ca. A.D. 200). Accompanying the pivot toward estuarine living was the spread of shell-tempered ceramics indexing regional social networks from the Delaware Bay to the mouth of the Chesapeake Bay. Survey and excavation data from the Naval Weapons Station Yorktown (NWSY) on the York River trace this process on Virginia's lower York River. Here, Middle Woodland populations established central places around the lower embayed portions of tidal creeks. Communal shell middens anchoring these central places offer evidence of intensive oyster harvesting and a history of periodic overharvesting, adjustment, and long-term sustainability. We hypothesize that common pool resource management, i.e., collective action and stewardship in the management of the oyster fishery, was an important part of Native societies' settling down in this region.

KEYWORDS

settling down, Woodland period, Chesapeake archeology, shell midden studies, shell-tempered pottery, common pool resource management

Introduction

Transitions from mobile to sedentary lifeways represent a longstanding focus of archeological research that has traditionally relied on evolutionary models assuming a close linkage between settlement patterns and subsistence modalities (e.g., Childe, 1936; Steward, 1949). As Feinman and Neitzel's (2023) reevaluation of "settling down" makes clear, the shift to larger, more permanent communities was not always tied to increased reliance on domesticated plants or even on limited mobility. This study underscores the need to consider *social relationships* influencing decisions about community affiliation and residential stability rather than solely environmental and demographic factors. The transition to sedentism requires considering how individuals and households navigated social relational challenges and opportunities, opening divergent paths toward greater residential permanence. In their analysis, Feinman and Neitzel demonstrate that as communities increased in size and interactive densities surpassed demographic thresholds, diverse interpersonal realignments ensued. These developments were often non-linear and oscillating, reflecting the dynamic nature of social organization and decision-making. The choices made by individuals and households in response to challenges posed by larger, more permanent settlements could lead to a range of outcomes, from year-round settlement to an outright refusal to settle down.

TABLE 1 Cultural phases in the study area.

Phase	Dates	Primary ceramics	Primary settlement types on the NWSY	Description
Varina	500 BC–AD 200	Lithic-tempered, varied surface treatments	Small upland encampments	Highly mobile; occasionally harvested oysters
Mockley	AD 200–900	Shell-tempered, cord- or net-impressed	Large villages around tidal creeks	First villages; dense shell middens; increased residential permanence
Townsend	AD 900–1300	Shell-tempered, fabric impressed	Dispersed villages around tidal creeks	Continued harvesting oysters; incorporated maize-based horticulture; twofold increase in population; decreased residential permanence
Roanoke	AD 1300–1607	Shell-tempered, simple-stamped	Dense villages around tidal creeks	Construction of a palisaded compound at 44YO2; continued harvesting large quantities of oysters; increased residential permanence

Along North America’s Atlantic coast, for example, studies have found evidence that villages arose with the establishment of collective action organized around the harvesting of fish and shellfish (e.g., Andrus and Thompson, 2012; Thompson, 2018, 2023; Garland and Thompson, 2023). For example, shell rings on the Georgia Coast represented early examples of village communities in North America, Thompson (2018, p. 22) suggests, rather than solely monumental or ceremonial sites. Village formation here and elsewhere presented collective action challenges related to longer coresidence and larger populations. Some Late Archaic forager-fishers made the decision to affiliate with shell ring villages as a way of cooperatively managing maritime resources, including locally available fish and shellfish. Canoe travel and the twice-daily tides fostered the collection of oysters and clams from a variety of salinity habitats, enabling shell ring villagers to manage resources effectively, avoiding overexploitation of any single shellfish bed.

As detailed in the following, we see evidence that a parallel historical process unfolded in the Chesapeake region to the north, though the evidence for a transition to larger and more permanent estuarine communities appears significantly later here. During the Mockley Phase (AD 200–900) of the Middle Woodland period, Native communities in the Chesapeake Coastal Plain settled down with a decisive pivot toward estuarine resources and riverine communities (Custer, 1989, pp. 141–184; Stewart, 1992; Potter, 1993, p. 103; Nash, 2020). At the same time, Mockley Phase communities constructed a regional scale network of social connectivity indexed by the spread of shell-tempered ceramics (Table 1). Coastal forager-fishers within this network reorganized their socioeconomic structures, settlement patterns, and technological modalities from the mouth of the Chesapeake to the Delaware Bay.

The Mockley Phase witnessed the creation of settlements with considerably higher levels of residential stability in conjunction with the first pan-Chesapeake material tradition, shell-tempered Mockley ceramics. Residential stability refers here to the span of time spent at a location during the annual cycle, which may range from less than a single day to an entire year (Gallivan, 2002). The Mockley Phase increase in residential stability predated the arrival of domesticates and of horticulture by centuries, and the social dynamics that followed influenced coastal communities through the colonial era. Mockley Phase villages appeared first in the southern part of the Chesapeake within the Outer Coastal Plain (i.e., the lower portion of the estuary

closest to the Chesapeake Bay) in locations accessible to oyster reefs and fishing grounds. Archeologists have long hypothesized that the process of settling down in the Chesapeake began in areas where forager-fishers gathered around settings with rich, diverse, and predictable resources (e.g., Gardner, 1982; Nash, 2020, p. 138). A remaining question concerns how the social relationships that formed around these estuarine resources changed during the Mockley Phase in ways that encouraged communities to form persistent places on the water.

The case study below considers the historical process of settling down in the lower York River area of the Chesapeake’s Outer Coastal Plain (Figure 1). We rely on an archeological survey of the Naval Weapons Station Yorktown (NWSY), a 14,000-acre military facility (Blanton et al., 2005) and an analysis of archeological shell from midden deposits within the base (Jenkins and Gallivan, 2020). The comprehensive survey of a landscape on this scale allows for “non-site” approaches to settlement patterns (Dunnell and Dancy, 1983) that highlight changing mobility practices and the establishment of persistent places along tidal waterways. Rather than relying on site boundaries, a non-site approach draws on shovel test data to consider the distributions and concentrations of materials across a landscape. Represented visually, these data allow for inferences regarding the places people dwelled and the pathways through which they traveled. Forager-fishers in the lower York constructed enduring communities around the lower embayed portions of tidal creeks that flow into the York River, establishing dispersed settlements anchored by large, community-scale shell middens. Analysis of the oyster shells deposited in these middens leads us to hypothesize that settling down in this part of the Chesapeake began as forager-fishers developed new social relationships around the collective management of the oyster fishery. Analyses of oyster shells presented here include comparisons of morphometric measurements (e.g., height, length, presence/absence of attachment scars, and presence/absence of epibionts) and the amount of oyster and other shellfish species across samples excavated from various deposits.

Preliminary evidence presented here points toward management practices that included selective harvesting of the fishery, a system of marine tenure, enhancement of oyster habitat, and shifts in the ratios of harvested shellfish species. Collectively, these practices represent a form of *common pool resource management*. Common pool resources are natural or man-made features like fisheries, forests, or irrigation

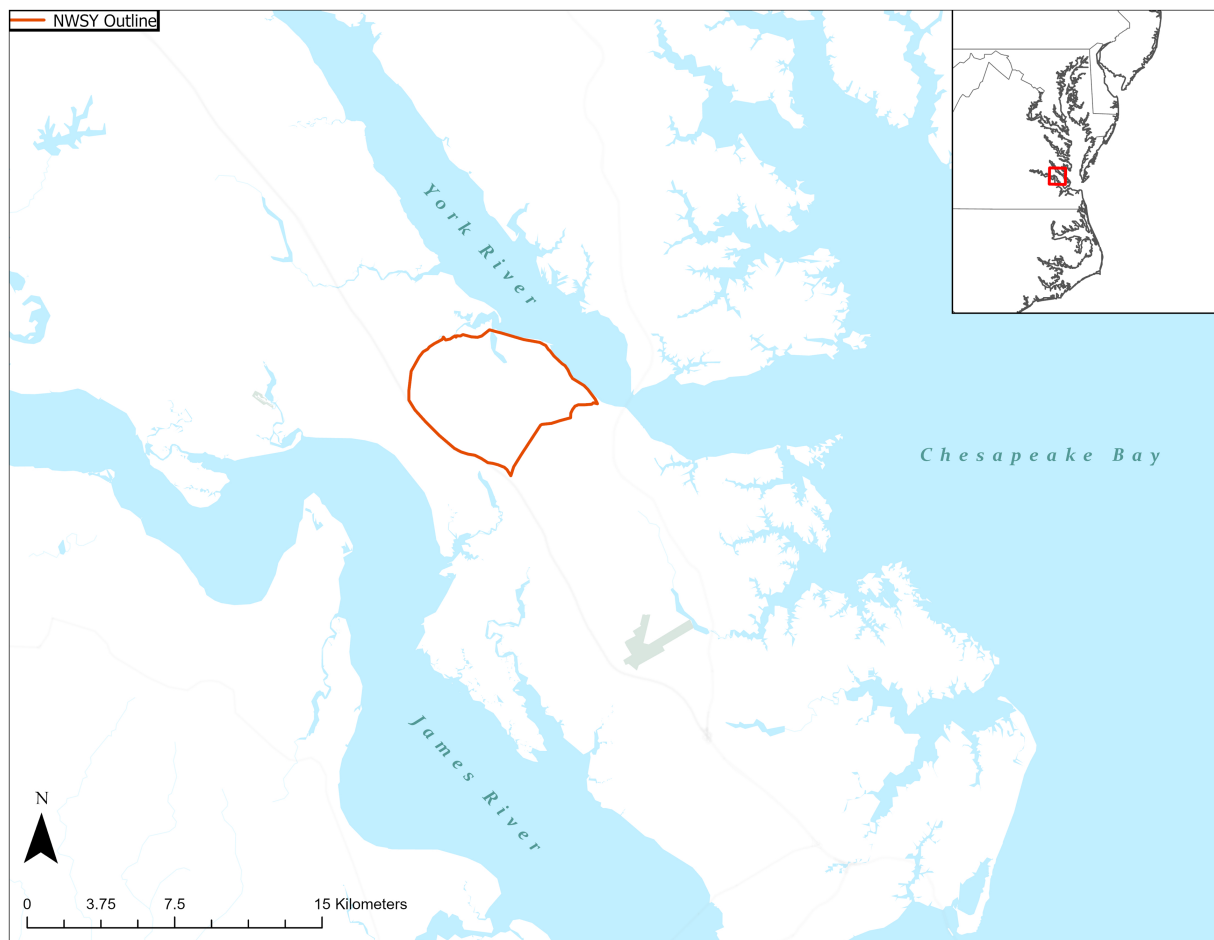


FIGURE 1
Map showing the location of the Naval Weapons Station Yorktown, Virginia. Map created by Sophie Thacker-Gwaltney.

systems shared by a community that require collective management to prevent overuse and depletion (e.g., [Lansing et al., 2014](#); [Aiuvalasit, 2019](#)). As detailed in the scholarship of [Ostrom \(2002, 2019\)](#), local communities often establish norms, rules, and institutional frameworks around these resources to foster equity and to block “free riders” from depleting these resources. The archeological and paleoenvironmental records from the NWSY suggest that collective action was aimed at maintaining the productivity of common pool resources, including the oyster fishery.

We see evidence that forager-fishers’ decisions to settle down along the waterways of the lower York were accompanied by a suite of practices tied to resource management. Drawing from historical and ethnographic sources, [Ostrom \(2019\)](#) observed that around the world, common pool resources are often effectively governed by local community-led institutions, independent of political authority or private ownership. Given the opportunity for cooperation and an effective set of rules, environmental degradation was by no means the inevitable result of collective use of the commons. Within the lower York ([Jenkins and Gallivan, 2020](#)) and across the wider Chesapeake ([Rick et al., 2016](#); [Reeder-Myers et al., 2022](#)) coastal communities harvested the oyster fishery intensively and sustainably on a millennial timescale.

Mockley Phase changes in the lower York River marked a significant social transformation in the ways Native people engaged with estuarine resources, moved through the landscape, interacted with one another, and experienced their world. As detailed below, not everyone in the Coastal Plain made the decision to settle down. Even as some individuals and households chose to reside in larger, more permanent estuarine settlements, others chose to maintain high mobility, small settlements, and a “traditional” socioeconomic orientation toward upland resources ([Blanton et al., 2005](#), p. 252). These generalist hunter-gatherers continued to produce lithic-tempered ceramics for the first four centuries of the Mockley Phase, regularly encountering the forager-fishers living along the water ([Blanton and Pullins, 2004](#); [Gallivan, 2016](#), p. 72). The product of socially complex and historically contingent factors, the Mockley Phase in the Chesapeake represents an important and formative shift toward “settling down.” The following traces the historical process of settling down in the Chesapeake through a consideration of the Coastal Plain during the Mockley Phase, a case study of the Naval Weapons Station Yorktown, and an interpretation of the sociality of management on the lower York River.

The Chesapeake coastal plain during the Mockley Phase: previous research

Named for its distinctive shell-tempered pottery, the Mockley Phase encompasses the latter half of the Middle Woodland period in coastal areas from the mouth of the Chesapeake to the Delaware Bay (Blanton, 1992; Stewart, 1992; Potter, 1993, pp. 103–114; Gallivan, 2011, pp. 289–294; Nash, 2020). Mockley Phase settlements were marked by shell-tempered pottery, an estuarine subsistence orientation, and dispersed riverine settlements, a suite of practices that remained in place through the early colonial period in the Chesapeake region.

Mockley pottery and other late middle woodland ceramics

Mockley ware vessels are coil-constructed jars with rounded bottoms tempered with crushed shell, typically oyster (Egloff and Potter, 1982, p. 103) (Figure 2). Prior to the Mockley Phase, ceramics in the Chesapeake included a dizzying array of lithic and sand tempers, surface treatments, and vessel forms with localized distributions, highlighting small-scale, closed interaction networks.

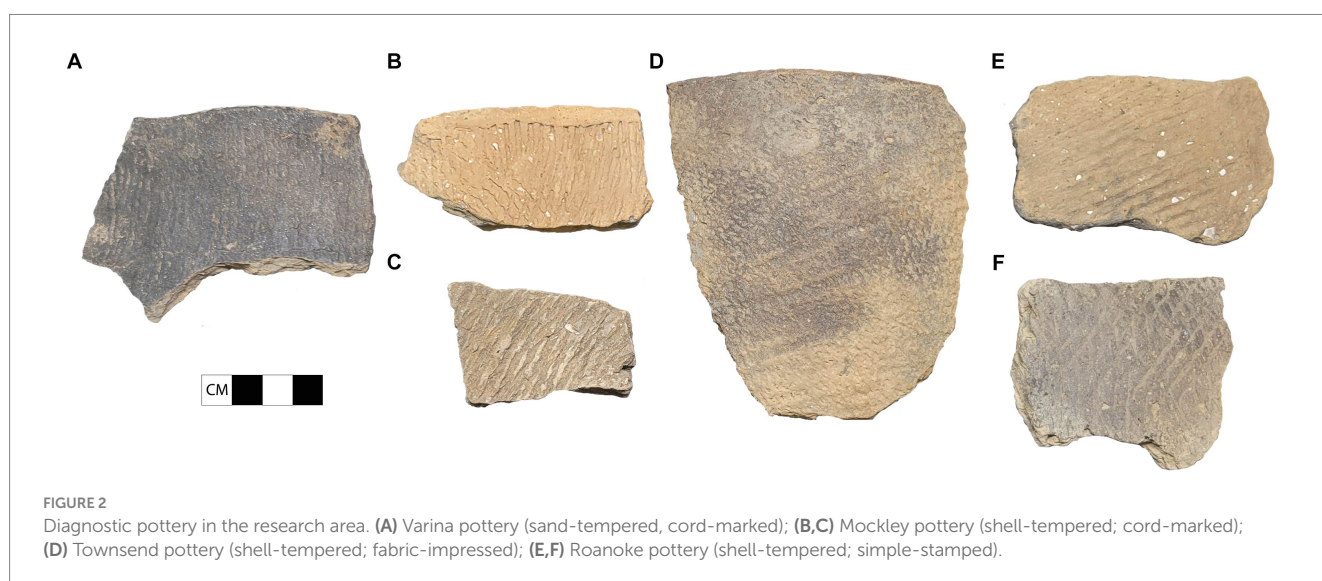
Studies of shell-tempering indicate that the practice offers functional advantages to ceramic vessels while also demanding more precise control over the firing process, making it challenging to produce (Feathers, 2006; Feathers and Peacock, 2008; Herbert, 2008; Rick and Lowery, 2013). Shell-tempering offers improved resistance to thermal shock and vessel strength over sand-, lithic-, or grog-tempered wares. Successfully producing a shell-tempered pot requires reducing the firing atmosphere and precisely controlling the burn. Lime spalling (i.e., when fragments flake away from the vessel body), may occur when the firing temperatures exceeds a threshold. Additionally, if shell-tempered pottery is not sufficiently fired, it can negatively affect vessel strength.

Even with the advantage of increased vessel strength offered by shell-tempered pottery, some communities in the Chesapeake Coastal Plain continued to make sand- and lithic-tempered pottery for several

centuries into the Mockley horizon. Sand- and lithic-tempered ceramics, including Varina ware, continued to appear within small, interior sites through AD 600 (Gallivan, 2016, p. 72). Given this selective adoption and the challenges of producing shell-tempered vessels, the shift to shell-tempering appears to have been as much a *social* innovation as a practical one. Estuarine-oriented communities' shell-tempered pottery may have served as a marker of their relational identity within a landscape where at least two social traditions coexisted. The shell-tempered ceramic tradition united coastal dwellers from the mouth of the Chesapeake Bay to the Delaware Bay within a large estuarine "interaction sphere" (Custer, 1990). The process of settling down in the Chesapeake evidently included a shift from small-scale, closed social networks toward open networks of marriage and alliance that eventually stretched across the Middle Atlantic coast. The earliest shell-tempered pottery appeared first alongside oyster reefs in the *southern* Chesapeake (Rick and Lowery, 2013) representing a "home grown" innovation accompanied by a suite of socioeconomic changes, including new settlement and subsistence patterns, community affiliations, and regional ties (Nash, 2020, p. 127). Mockley pottery incorporated crushed particles of the very shells around which estuarine communities gathered, raising the possibility that the ware was emblematic of the practices and places linking estuarine communities across the coastal Middle Atlantic.

Late middle woodland settlement

Mockley Phase sites in the Chesapeake highlight an historic process of settling down around rich and predictable estuarine resources (Custer, 1990; Blanton, 1992; Potter, 1993; Dent, 1995; Nash, 2020). The settlement pattern data from this period point to a seasonal round—or perhaps two connected seasonal rounds—scheduled to capitalize on the peak availability of productive staples such as shellfish, anadromous fish, mast, and deer. Communities using Mockley ceramics focused on the estuarine and riverine portions of this landscape. Places of seasonal aggregation containing dense concentrations of Mockley ceramics included locations in the lower, brackish portion of the estuary near oyster reefs and clam beds



harvested during the fall and winter months. Other large Mockley Phase sites were located upriver, marking spring and summer gatherings located near anadromous fish runs. Where the settlement round of Mockley forager-fishers aligned with the linear pathways of the Chesapeake estuary, communities producing Varina pots continued to make repeated use of interior encampments with ready access to mast and deer. *Circa* AD 200–600, hunter-gatherer groups using Varina ceramics continued to circulate between upland encampments in the same mobile settlement pattern used in previous centuries. Where these groups came into contact, the archeological record hints that foods may have been exchanged as a result of the “mutualism” of different hunter-gatherer groups (Blanton and Pullins, 2004).

Along with an increased settlement focus on the Outer Coastal Plain, large Mockley Phase settlements also appeared in some Inner Coastal Plain locations, including areas associated with anadromous fish runs. Anadromous fish live most of their lives in the ocean, returning to freshwater to spawn. In the Chesapeake, striped bass, sturgeon, alewife, and herring migrated in large numbers to the Inner Coastal Plain during the spring. These species provided a rich and predictable resource for those communities with the requisite traditional ecological knowledge and willingness to act collectively to construct weirs in the freshwater shallows of tidal creeks (Holmes, 1907).

Located in the James River’s Inner Coastal Plain, the Maycock’s Point site represents a large Mockley Phase settlement near the mouth of a freshwater creek (Opperman, 1992; Makin, 2018). The site is marked by a dense Mockley Phase midden containing faunal material from a range of terrestrial and riverine species, including eastern elliptio (*Elliptio complanata*), a freshwater mussel. This site’s substantial size and resource-rich location make it a prime example of settling down in the Inner Coastal Plain alongside freshwater mollusks and anadromous fish runs (Nash, 2020, p. 142). Faunal analysis of Maycock’s Point’s midden deposits suggests a warm weather occupation (Opperman, 1992, p. 90), aligning with the understanding that anadromous fish runs drew residents to the location on a seasonal basis.

Alongside the Mockley ceramics recovered from Maycock’s Point’s midden are similar shell-tempered ceramics decorated with elaborately incised linear designs (Makin, 2018) (Figure 3). The designs on these Abbott zone-decorated ceramics include combinations of horizontal and vertical lines incised into the vessel, sometimes in the form of nested triangles, diamonds or cross-hatching in distinct zones below the rim. Abbott zoned-decorated ceramics occur as a minority ware on Middle Woodland sites from Virginia through Massachusetts in locations of seasonal aggregation where communities fished and harvested shellfish, leaving behind thick midden deposits (Stewart, 1998). In the Chesapeake, similar zone-decorated ceramics have been found at five sites in the James and York River drainages. Abbott zone-decorated vessels were likely used on special occasions when seasonal fish runs gathered large groups for seasonal aggregations during warm weather months. The intricate incised designs on Abbott ceramics appear to represent fish and fishing-related equipment, including nets and weirs (Lattanzi et al., 2015). The designs on these ceramics may have played a role in establishing and reinforcing social identities in the context of feasting events and collective action to build and repair fish traps (Hantman and Gold, 2000).

Naval Weapons Station Yorktown case study

Where Maycock’s Point offers evidence of a Mockley Phase settlement in the Inner Coastal Plain, the pathway toward greater residential permanence in the coastal Chesapeake may be examined through a case study of the Naval Weapons Station Yorktown (NWSY), a military base on the lower York River covering more than 33,000 hectares (see Figure 1). Archeological survey and excavation on the NWSY offers a detailed view of precolonial settlement history in the Outer Coastal Plain (Blanton et al., 2005). The 246 sites identified by the NWSY survey represent almost the entire span of the human past in eastern North America. Sites dating from before 1000 B.C. were oriented toward higher elevations and interior locations, away from the York River and the tidal creeks. During the Varina phase (500 BC–AD 600) the number of sites on the NWSY increased significantly, especially small, single component encampments in interior settings away from the creeks and the York. *Circa* A.D. 200, at the outset of the Mockley Phase, the number of sites along the York River and lower portions of the tidal creeks again increased with a pivot toward estuarine settings that continued through Contact. The survey data highlight increasing population during the Mockley Phase and the creation of a new settlement form, the creek-based dispersed village community, spread around the lower embayed portions of Indian Field and Felgates creeks.

Starting during the Mockley Phase, a series of spatially separate but socially connected sites overlooking Indian Field creek comprised one of these dispersed creek-side villages (Figure 4). Domestic spaces with associated shell middens dating from AD 200 to the early seventeenth century wrapped around the creek where it empties into the York, and two large shell middens at sites 44YO2 and 44YO687 were located near the creek’s confluence with the York (see Figure 4). Excavation at site 44YO2 has revealed a palisade and ditch feature dating to the subsequent Townsend phase (AD 900–1300), when maize-based horticulture was incorporated into subsistence practices (Figure 5). The colonial era town of Kiskiack starts to come into view on Indian Field Creek during the following Roanoke phase (AD 1300–1607). Bluff-top locations overlooking Indian Field Creek and the York River contain dense midden deposits and domestic structures dating to these centuries, highlighting continued population growth. By the early colonial era, Kiskiack appears on colonist Smith’s (1986) *Map of Virginia* as a “King’s House,” one of about 30 regional political centers within the Powhatan paramount chiefdom. Across the river from Kiskiack, Smith’s map depicts Cantanuck and Capahosic, two “Ordinary houses” lacking Kiskiack’s political authority.

Using survey data to reconstruct settlement histories on the NWSY

Reevaluation of the comprehensive shovel test survey of the Naval Weapons Station (Blanton et al., 2005) has allowed us to take a non-site approach to interpreting people’s movement throughout the lower York River landscape. The archeological sites identified within the area imply discreet and spatially bounded areas of human activity (see Figure 4). While this visualization of cultural resources is quite valuable for modern land management, bounded polygons do not accurately reflect past human movement through and engagement

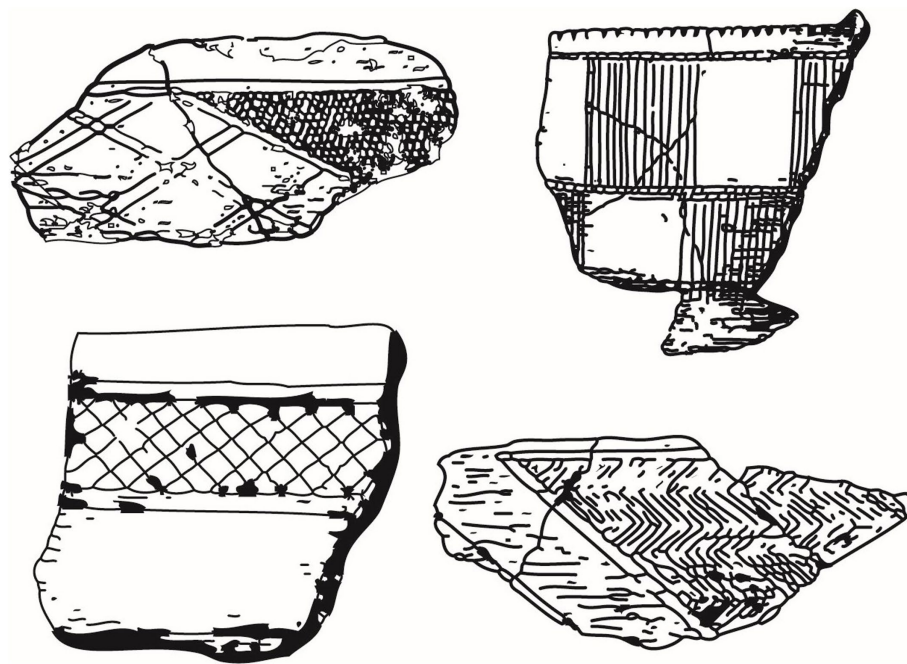


FIGURE 3
Examples of Abbott zoned incised pottery.

with the landscape (Dunnell, 1992). By considering the results of shovel testing without the imposition of site boundaries, we can consider landscape-scale distributions of artifacts and ecofacts that provide insights into movement, mobility, and residential stability (Foley, 1981). This approach allows us to think of past people and their worlds as in motion, and to consider how past practices and social relationships created the archeological record in relation to the landscape.

Using a non-site approach, our research team mapped the distribution of temporally diagnostic pottery and oyster shell density within the NWSY (Figure 6). Focusing on Indian Field Creek and Felgates Creek, several patterns emerge:

- 1 There is a significant increase in the number of diagnostic sherds between the Varina and Mockley Phases and again between the Mockley and Townsend phases.
- 2 Distributions of diagnostic pottery overlap at many locations.
- 3 Mockley pottery's distribution includes large concentrations of sherds spread out along the creek and riverbanks.
- 4 Townsend pottery is ubiquitous, but less concentrated than Mockley pottery, covering a larger geographic extent.
- 5 The geographic scope of Roanoke pottery becomes restricted once again, with dense concentrations near the mouths of creeks.

While these patterns likely index increased population through time, they also shed light on the creation of persistent places and the movement of people within the landscape. Specifically, these patterns offer evidence of high levels of mobility associated with hunter gatherers using Varina ceramics, place-making and settling down into dispersed creek-side villages during the Mockley Phase, and a shift toward decreased residential permanence in the following Townsend

phase. In the final Roanoke phase, the limited distribution of sherds across the landscape almost mirrors the settlement patterns of the Mockley Phase and coincides with the creation of a palisaded compound on the east side of Indian Field Creek (see Figure 5). At this time, it appears that Kiskiack's residents once again increased their residential stability while restricting much of their movement to the bluffs overlooking the York River and tidal creeks.

The overlap in diagnostic ceramics on the landscape offers evidence of some continuity in landscape usage after AD 200. However, one of the drawbacks of shovel test data is the lack of tight temporal control. While diagnostic artifacts help us interpret change over time, there is also a considerable overlap in the date ranges of diagnostic types in the region (see Table 1). Therefore, the presence of both Varina and Mockley pottery in one place could indicate the location of a persistent place that was occupied or visited across centuries, a place of social interaction between two contemporaneous communities between AD 200 and 600, or both. Further excavation and research at these sites will help to parse out this ambiguity. There are also several places across the NWSY landscape with both Mockley and Townsend pottery. However, whereas most places with Mockley pottery also have Townsend sherds, not all places with Townsend pottery also have Mockley sherds. We suspect that this represents a transformation of settlement practices, where people moved more often during the Townsend phase as agricultural fields were cleared and others were left fallow. In fact, when English colonists arrived in the region in the seventeenth century, they observed that Powhatan communities in the area routinely moved their settlements as they cleared new agricultural fields, with towns moving "amoebalike" up and down waterways (Rountree et al., 2007, p. 33).

Shovel test data show that oyster shell is distributed across the landscape in variable densities. The highest oyster concentrations on land are found on the east sides of creek mouths alongside dense

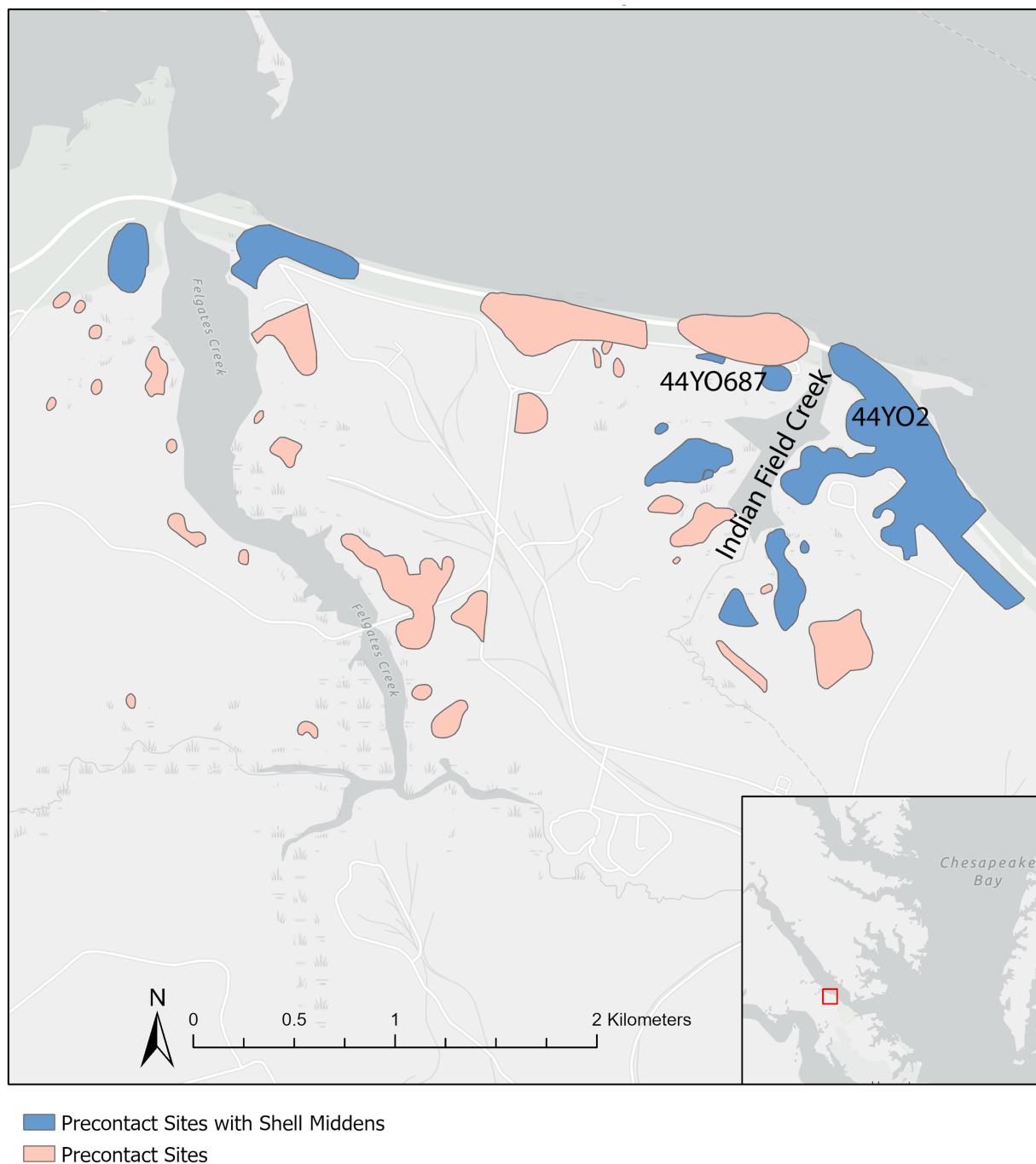
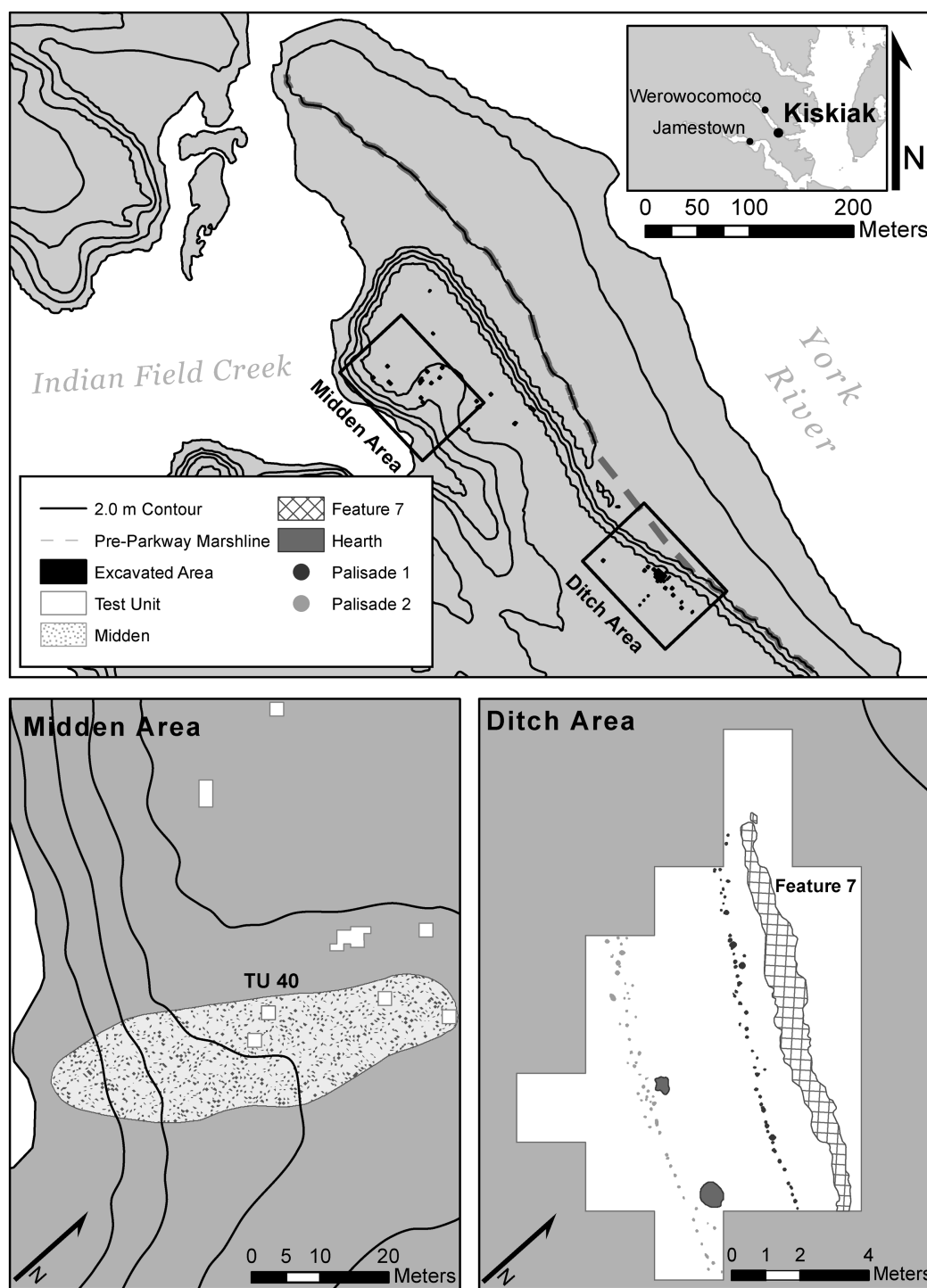


FIGURE 4

Map showing the location of sites around Indian Field Creek and Felgates Creek on the Naval Weapons Station Yorktown. Map created by Sophie Thacker-Gwaltney.

concentrations of Mockley and Townsend sherds (see Figure 6). Excavation at creek-side villages on the lower York River have revealed three types of oyster-rich deposits: the King's House Midden at 44YO2, community middens on sloping landscapes leading to the creeks, and ephemeral household middens in upland areas (Jenkins et al., 2023). Oyster shells are also found within short-term or special use deposits such as oyster roasting pits or the oyster-filled ditch feature associated with the thirteenth-century palisaded compound at 44YO2. The largest identified shell midden on the NWSY is located on

the east side Indian Field Creek and measures 50 by 25 meters with a depth of over two meters (see Figure 5). We have labeled this deposit as the King's House Midden due to its proximity to Kiskiaki's palisaded compound. Other large concentrations of oyster shell along the edges of creeks appear to represent community-scale middens created by routine and extensive oyster harvesting and consumption by settled, creek-side villagers. The lighter distribution of oyster shell identified by shovel test survey in blufftop areas appears to represent household middens located alongside domestic spaces.



Kara Garvey, 2018. NAD 1983 HARN State Plane Virginia South. Lambert Conformal Conic. Data Sources: USGS; ESRI; WMCAR.

FIGURE 5

Map showing excavated areas and features at site 44YO2 on Indian Field Creek on the Naval Weapons Station Yorktown.

Based on the excavation of the King's House Midden at 44YO2, we have estimated that the number of oysters harvested between AD 200 and 1600 by forager-fishers settled at this location likely exceeded 70,000,000 (Jenkins and Gallivan, 2020, p. 19). When this number is extended to include the estimate of oysters deposited in other middens (i.e., household middens and community middens) and shell-rich deposits around Indian Field Creek, the number of oysters harvested

by this single settled community likely exceeded 200,000,000. If we consider this estimate alongside historical ethnography indicating that oysters were only harvested during half the year, then our evidence suggests that the community settled around Indian Field Creek likely collected 5,000 oysters per week, primarily from the waters surrounding the settlement. With an estimated 150 residents living in distributed settlements around Indian Field Creek *circa* 1607,

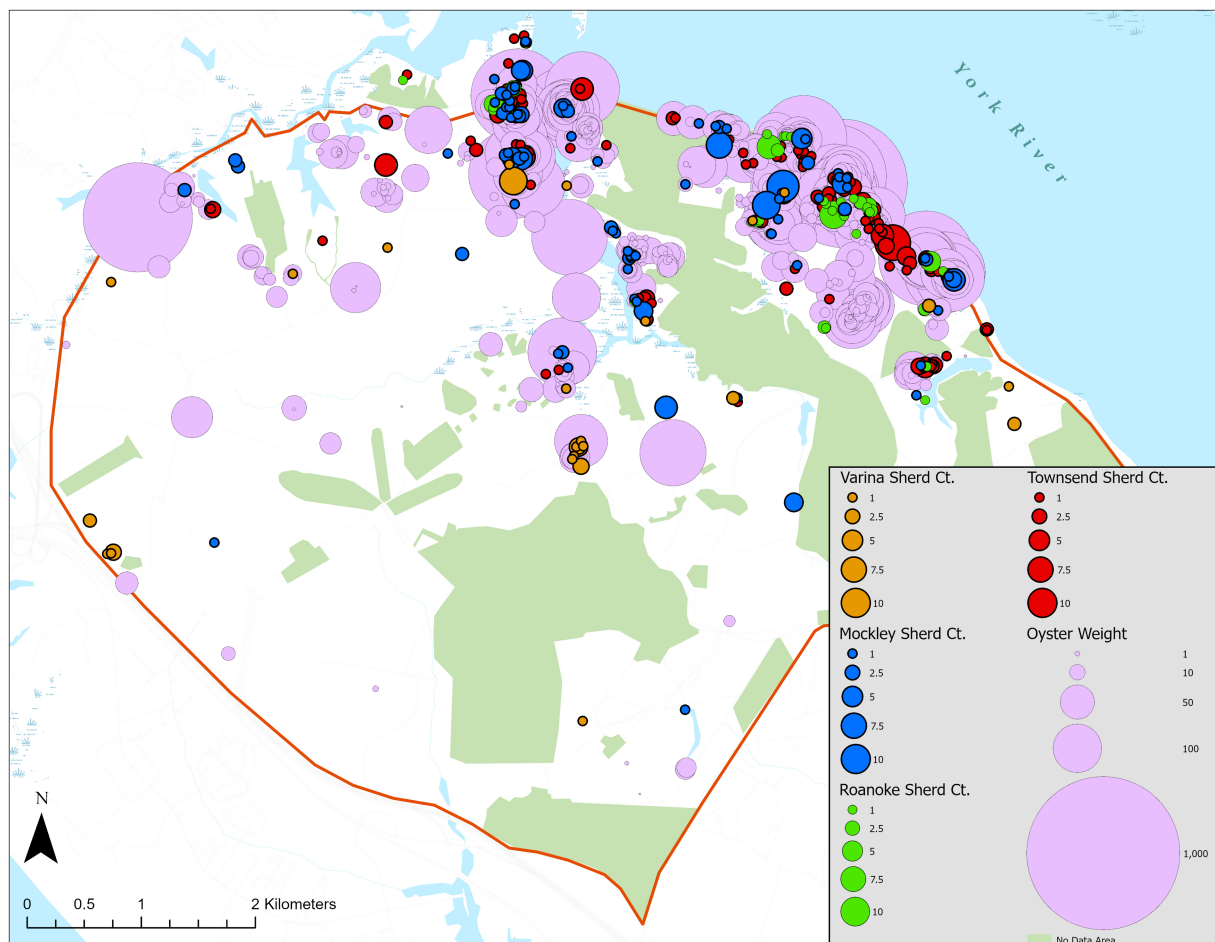


FIGURE 6

Map showing the distribution of diagnostic pottery and oyster (measured in grams) encountered during shovel testing on the Naval Weapons Station Yorktown. Map created by Sophie Thacker-Gwaltney.

this amounts to a consumption rate of about five oysters per person per day, which is not only reasonable, but likely at the low end of the actual harvesting and consumption rates given historical accounts of regular oyster consumption punctuated by communal feasts centered on large quantities of shellfish.

The sociality of management in the Chesapeake's outer coastal plain

Feinman and Neitzel's (2023) model draws attention to social realignments linked to the stresses and cognitive limits of larger, more permanent communities and the types of resources available to those electing to settle down. In the Chesapeake during the Mockley Phase, community and intercommunity relationships were renegotiated as people settled into creek-side villages, and the distribution of oysters and fish runs were integral to the resulting social arrangements. Following Thompson (2018, p. 27), we suspect that Mockley Phase settlement shifts meant that people residing along waterways throughout the Chesapeake encountered one other on a more regular basis as they moved throughout the new waterscape, exploited estuarine species, and gathered at places of social and cosmological

importance. A series of creek-side villages appeared during the Mockley Phase in close proximity on the lower York River, and canoes facilitated fast travel between Indian Field and Felgates creeks and across the river to Cantauuncack and Capahosic, the "Ordinary Houses" within Kiskiaki's orbit. With the significantly larger populations of the Mockley period and the connectivity afforded by the Chesapeake estuary, we suspect that a new set of rules or principles were established governing access to and management of estuarine resources within these waterways. As detailed below, patterns and practices related to collective management on the lower York River may be considered in terms of selective harvesting of resource patches, a system of marine tenure, deliberate enhancement of resource habitat, and shifts in the ratios of targeted shellfish species.

Selective harvesting of resource patches

Archeological evaluations of the sites that comprised the dispersed creek-side village at NWSY included excavations on the east side of Indian Field Creek (Blanton et al., 2005, pp. 27–70; Gallivan, 2016, pp. 68–103). This portion of Kiskiaki, designated site 44YO2, was bounded by a ditch and palisade feature constructed in the thirteenth

century AD along the bluff above the York River (see Figure 5). Located 400 meters west of this feature along the water's edge, a stratified shell midden along Indian Field Creek extends approximately 50 by 25 meters in plan and two meters in depth. Our preliminary assessment of oyster management at Kiskiack centered on a comparison of the shells deposited in this large midden and in the ditch feature (Jenkins and Gallivan, 2020). The shells in the midden and in the ditch represented different sets of harvesting and consumption practices, with the ditch oysters likely associated with feasting practices distinct from the regular consumption of oysters deposited in the midden. Our analysis indicated that Kiskiack's residents harvested primarily nearshore oysters, even though they were fully capable of taking deepwater oysters and did so occasionally to provision feasts. These selective harvesting practices likely contributed to the sustainability of the oyster fishery. Nearshore oysters represent net sink populations (i.e., reefs that cannot sustain themselves without individuals migrating in from source populations, such as the parent reefs located in offshore, deepwater settings).

Our study of oysters deposited in the King's House Midden demonstrates that the intensive level of harvesting described above was sustainable, with mean oyster height (i.e., size) decreasing marginally during the initial zenith of oyster harvesting (*circa* A.D. 600), and then rebounding in the following centuries, even as people continued to extensively harvest nearshore reefs (Jenkins and Gallivan, 2020, p. 15). Given the evidence of substantial population increases in the area and continued residence in creek-side settlements, this pattern suggests that forager-fishers likely engaged in management of this valuable resource.

Marine tenure

On the NWSY, Mockley Phase creek-side villages were arranged along the bluffs overlooking creeks tributary to the York River. These distributed settlements formed a U-shape oriented around a central body of water. Large, dense shell middens accumulated on the slopes at creek mouths. Similar to plazas in other North American Indigenous settlements, creeks served as central places of collective action within communities, including shellfish gathering and fishing using weirs. We hypothesize that a system of marine tenure was set in place at the start of the Mockley Phase. Within this system, creek-side villages maintained control over fish weirs and shellfish within the creek along which they settled, while offshore reefs in the York River channel were regulated as a shared resource governed by rules that limited harvesting to special occasions.

In this way, we suspect that offshore reefs represented public goods in contrast to the intertidal reefs controlled by creek-side communities. A public good refers to a resource that is non-excludable and non-rivalrous, meaning that it is impractical to exclude others from accessing it and the consumption of the resource by one individual does not reduce its availability to others. As well as solving a collective action problem around access to public goods, this arrangement likely functioned as an effective management strategy whereby nearshore intertidal oyster populations were regularly harvested, and offshore populations were mostly conserved and left to spawn.

Evidence for a system of marine tenure and management is supported by patterning within a subsistence column from site

44YO2's midden, which contains stratified deposits spanning the Late Archaic period through colonial contact (Jenkins and Gallivan, 2020). Recovered material included vertebrate faunal remains (bird, deer, drum, and small fish vertebra), lithics, and oyster and clam shells. The recovery of the remains of small fish from the midden points toward the use of fish weirs during the Mockley Phase. As described by Jamestown's colonists (e.g., Strachey, 1953, p. 68), fish weirs in the Chesapeake consisted of complex enclosures made from woven reeds:

...their weares in which they take their fish, which are certaine inclosures made of reedes, and framed in the fashion of a laborinth or maze sett a fathome deepe in the water, with divers chambers or bedds, out of which the entangled fish cannot returne or gett out, being once in. Well maye a great one, by chaunce, breake the reedes and so escape, otherwise he remains a pray to the fishermen the next lowe water, which they fish with a nett at the end of a pole.

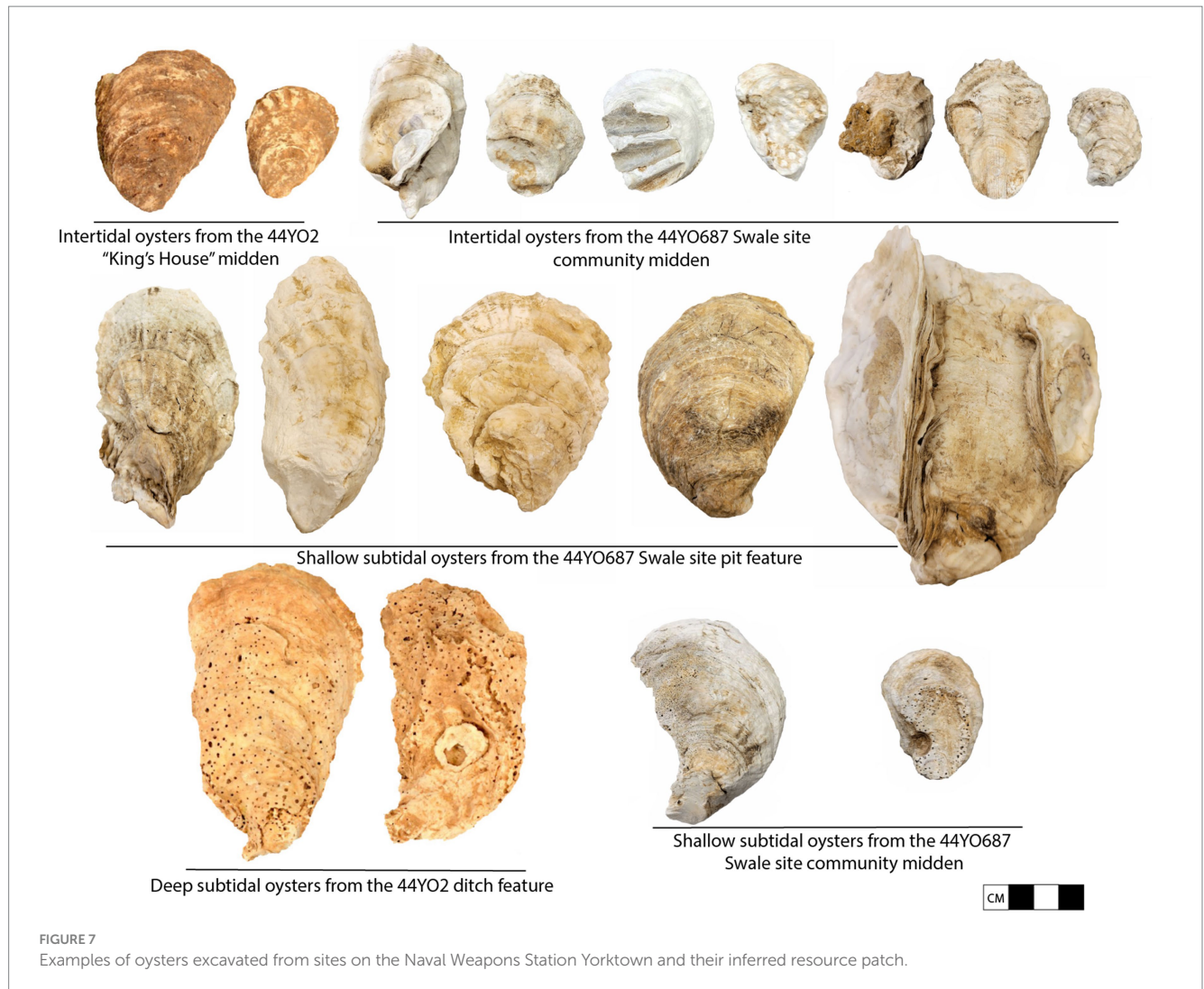
The construction, maintenance, and monitoring of fish weirs required collaboration and cooperation among villagers residing nearby (Thompson, 2018, pp. 25–26). Moreover, if controlled by individual creek-side villages, the use of weirs may have afforded fishing rights associated with specific communities (Reitz, 2014; Thompson, 2018, p. 26).

Our analysis of oyster shells excavated from the subsistence column at 44YO2 presented in Jenkins and Gallivan (2020) indicates that they are, on average, relatively small (less than 60 millimeters in height), 2–3 years old, and most were harvested from intertidal reefs located nearby, along the water's edge. During the Mockley Phase, about 20 percent of the oysters show evidence that they were harvested from offshore reefs, indicating limited access to these reefs, possibly as a result of agreed-upon principles governing access to these resources as public goods. Conversely, oysters from a feasting deposit within Kiskiack's palisaded compound are significantly larger than those in the midden and most show evidence that they were harvested from offshore, subtidal reefs (Jenkins and Gallivan, 2020, p. 16).

To better understand the archeological signature of marine tenure, we developed a model of the morphology and bioindicators of oyster shells local to the lower York area. As part of this effort, we assembled a team of interdisciplinary researchers consisting of archeologists, geologists, and marine scientists to sample and measure modern oysters from different resource niches that spanned tidal and salinity zones (i.e., nearshore versus offshore, shallow water versus deep water) of the lower York River. Preliminary results indicate that oyster morphology and bioindicators vary in statistically significant ways by tidal zone and across creeks in accordance with salinity, water depth, stream flow rates, and available substrate (Jenkins and Gallivan, 2022). These results confirm our hypotheses as well as the work of Kent (1988) and Lawrence (1988), demonstrating that it is possible to infer which oyster resource patch was harvested by past people through analyses of oyster shell morphometrics and bioindicators (Figure 7).

Habitat enhancement

Alongside evidence of marine tenure and selective harvesting, our research suggests that past people enriched the local oyster habitat around Indian Field Creek by mobilizing fossilized scallop shells



(*Chesapecten jeffersonius*) as substrate for nearshore oyster spat attachment (Jenkins and Gallivan, 2020, p. 14). During the Mockley Phase, nearly 50 percent of oysters deposited in the midden at 44YO2 have attachment scars in the form of fossilized scallop shells. Importantly, fossilized scallop shells are only found in eroding outcrops of the Yorktown Formation geological strata and there is no natural Yorktown Formation outcrop proximate to 44YO2. Moreover, none of the modern oysters harvested from the intertidal or shallow subtidal zones of Indian Field Creek during the summer of 2022 have fossilized scallop shell attachment scars, whereas modern oysters from the intertidal zones of the three creeks proximate to Yorktown Formation outcrops were marked by such scars. Fossilized scallop shells are heavier than oyster shells and can better withstand the tidal environment of Indian Field Creek, acting as an effective anchor for juvenile oysters to attach to as they mature prior to harvesting. Fragments of fossilized scallop shells likely ended up in midden deposits as a byproduct of oyster harvesting in the intertidal zone. Evidence of substrate creation using these fossils is further supported by the increased ratio of fossilized shell to oyster shell during the Mockley Phase documented in survey data reported by Blanton et al. (2005, p. 235) (Figure 8). Our data, as well as those compiled by Blanton and colleagues, point toward the mobilization of fossilized

shell as substrate even prior to the Mockley Phase, as people settled down along Indian Field Creek and harvested oysters, demonstrating a deep-seated tradition and long-term ecological knowledge associated with oyster harvesting and propagation in this location.

Shellfish species ratios

A final line of evidence suggesting management of the oyster fishery during the Mockley Phase can be seen in the ratio of shellfish species found in midden deposits. Shell weight data compiled by Blanton et al. (2005, p. 235) documents a three-fold increase in oyster shell deposited in creek side middens between the Varina and Mockley Phases alongside a roughly equal amount of clam (*Mercenaria mercenaria*) shells (see Figure 8). This is the first and only time in the history of shellfishing on the NWSY where the weight of clam shells is roughly equivalent to the weight of oyster shells recovered from creek-side middens. Clams were harvested from Indian Field Creek both before and after the Mockley Phase in lower quantities, signaling their availability throughout Kiskiak's occupational history. Indian Field Creek is located in the high-density zone for clams on the York River, with a salinity of approximately 15–18 parts per thousand (ppt)

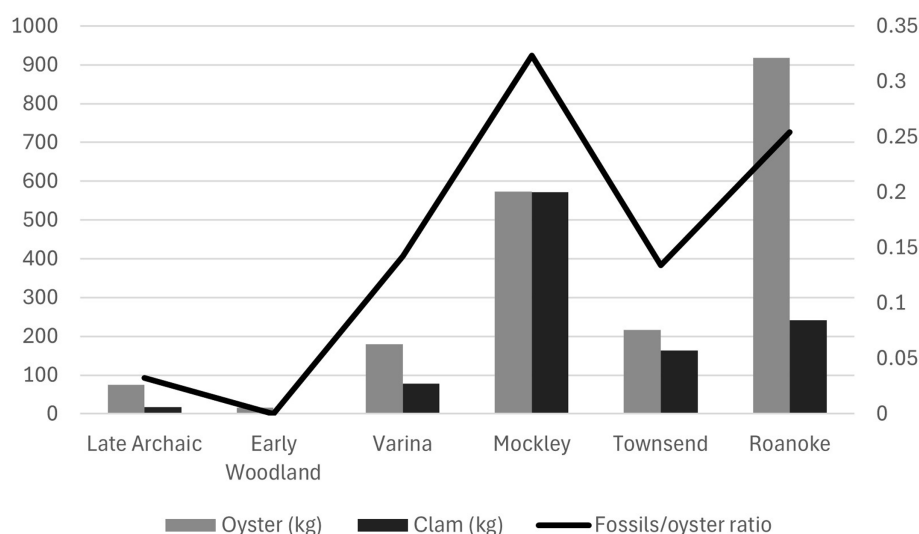


FIGURE 8

The ratio of fossilized scallop shell to oyster and changes in oyster and clam weight during different cultural phases on the Naval Weapons Station Yorktown (data from Blanton et al., 2005, p. 35).

(Roegner and Mann, 1990, p. 5). The Chesapeake Bay estuary was essentially complete by about 3,000 years ago (Dent, 1995, p. 84), with only modest shifts in salinity regimes since then.

The significant increase in clam harvesting during the Mockley Phase may relate to environmental changes that triggered alterations in clam habitat, however it seems more likely that this pattern was the product of changing harvesting practices. Whether the result of intentional management strategy or not, the Mockley Phase deposits document increasing comparable relative abundance in weight (kg) in targeted shellfish, even while the number of identified shellfish taxa remained low. A shift away from a heavy reliance primarily on oysters likely allowed shellfish resources to be harvested at a high rate while distributing the predation pressure between two species, reducing the chances of overharvesting and population decline of either one.

Summary

While we still have much to learn about the history of settling down in the Chesapeake region, we see evidence that collective action by creek-side villagers during the Mockley Phase played a vital role in this historical process. Evidence points toward selective harvesting of resource patches, a system of marine tenure, habitat enhancement, and shifting shellfish species ratios. While some of these strategies may have been employed by earlier people, our evidence suggests that formal institutions of common pool resource management were instantiated during the Mockley Phase. Between AD 200 and 900, community size and residential stability increased, and creek-side villagers focused their resource procurement on estuarine species, including fish and shellfish. Management of the fisheries was a social process that required collective decision making, cooperation, and collaboration. Resource management and new social arrangements afforded by settling down increased interaction within and among communities as they moved throughout the land- and waterscapes of the lower York River.

Discussion

Archer (1998, p. 119), one of the Jamestown Colony's original settlers, wrote of the Chesapeake region as a land of braided streams that abounded with fish and forests:

Here be many small rivers of brooks which unlade themselves into this main river at several mouths, which veins divide the savage kingdoms in many places, and yield pleasant seats in all the country by moistening the fruitful mold [i.e. land]. The main river abounds with sturgeon very large and excellent good, having also at the mouth of every brook and in every creek both store and exceeding good fish of divers kinds; and in the large sounds near the sea are multitudes of fish, banks of oysters, and many great crabs rather better in taste than ours.... It is generally replenish'd with wood of all kinds and the fairest, yea, and best that ever any of us (traveler or workman) ever saw.

Writing in 1607, Archer was struck by the Chesapeake's resource richness, as well as the ways estuarine waterways defined Native political territories. These densely populated "kingdoms" were built upon estuarine towns settled by earlier generations around oyster beds and fish weirs.

A deep history of Native settlement in the Coastal Plain suggests that fishery management powered by traditional ecological knowledge played an instrumental role in the historical process of settling down in the Chesapeake. Anchored by shell middens and fish weirs, Mockley settlements represent the first large and enduring communities in the region. Evidence from Mockley shell middens suggests that collective action aimed at conserving and enhancing the productivity of local fisheries played a role in the establishment of creek-side villages occupied for centuries.

As in other places, settling down in the Chesapeake was not tied to the adoption of domesticated plants, as maize-based horticulture arrived centuries later in the Chesapeake (*circa* AD 1100). Nor did

settling down in the Chesapeake bring an end to individual or household mobility. Mockley Phase communities appear to have embraced a seasonal pattern of movement up and down the region's rivers, gathering around shellfish beds and anadromous fish runs at alternating times of year. Riverine travel allowed residents of these communities to cover considerable distances, and canoe-borne mobility likely played a role in the spread of the Mockley tradition from its origins in the southern Chesapeake to the north side of the Delaware Bay. An expanding social network resulted in the Mockley interaction sphere, bringing shell-tempered ceramics and estuarine-oriented lifeways to communities across an expansive region. This process was not unidirectional or irreversible, as indicated by the dispersal of small farmsteads with the arrival of maize during the subsequent Townsend phase. Residential mobility appears to have increased during this period, as residential settlements dispersed across the landscape and shifted locations more frequently.

Archeological evidence from the lower York River suggests that settling down in the Chesapeake resulted from a set of decisions to focus on estuarine resources and a reorganization of social relationships. Not only did shell-tempered ceramics index a new settlement orientation, but the ware also traced an opening up of social networks and a broadening of regional ties. Even with the expanding scope of coastal settlements incorporated within the Mockley interaction sphere, some groups opted out of the decision to affiliate with creek-side villages. In the lower York River, the coexistence of distinct material traditions and divergent settlement rounds from AD 200 to AD 600 suggests that not everyone in the area chose to pivot toward waterfront living, even when they could do so. These contrasting patterns bring into sharp relief the importance of decision-making and agency in the history of settling down in the Chesapeake. During the critical Middle Woodland centuries when communities first settled down in the Chesapeake, the decision to affiliate with creek-side villages was evidently one that some individuals and households made willingly, whereas highly mobile foragers continued to focus their settlement and subsistence practices on upland resources for generations into the Mockley Phase.

Our ability to infer from the archeological record the collective action, harvesting guidelines, and institutional arrangements of Mockley Phase forager-fishers is admittedly limited, though the evidence points toward a suite of practices that sustained the oyster fishery across centuries of intensive harvesting. Selective harvesting of the oyster fishery left the deep-water reefs largely intact, even as communities exploited this resource patch occasionally. Forager-fisher communities appear to have adopted a system of marine tenure structured around the lower, embayed portions of tidal creeks, starting with the Mockley Phase. Communities in the lower York also enhanced oyster habitat by adding substrate to the waterways in the form of fossilized shell. A shift in the ratios of harvested shellfish species accompanied the Mockley Phase, highlighting practices that alleviated harvesting pressure on these resources. The archeological record of these practices indicates that they became more prominent during the Mockley Phase, during the centuries after groups in the Outer Coastal Plain elected to settle down. Our future research will include evaluating and incorporating further lines of evidence, including isotopic sclerochronology to address seasonality and refining the chronology through additional radiocarbon dates and Bayesian modeling of settlement histories.

Collective action and successful stewardship of the oyster fishery in the lower York River required locally organized techniques, decision-making structures, and rule frameworks that defined user communities, organized extraction, and maintained yields and harvests (Robbins, 2020, p. 53). The archeological evidence highlights the management practices of Mockley Phase forager-fishers, in part due to the durability of oyster shells and their accumulation in stratified midden contexts. Once they elected to settle down, Native people in the Chesapeake did more than simply manage and consume oysters. Understanding the broader scope of collective action in the Chesapeake and its relationship to the establishment of persistent places will require expanding our gaze to include other domains and data sets. As colonist Gabriel Archer's quotation above suggests, the estuary supported a rich and diverse range of fisheries beyond oysters as well as highly productive forests. Rather than a pristine wilderness with a sparse population and minimal Native impact, we see evidence of management that produced the highly productive estuarine waterscape and landscape described at contact.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

JJ: Conceptualization, Writing – original draft, Writing – review & editing. MG: Conceptualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. Funding for open-access publication of this research was provided by Flagler College.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Aiuvalasit, M. J. (2019). "Identifying common Pool resources in the archaeological record: a case study of water commons from the north American southwest" in *Global perspectives on long term community resource management*. eds. L. R. Lofgren and T. H. McGovern (Cham: Springer), 281–306.
- Andrus, C. F., and Thompson, V. D. (2012). Determining the habitat of mollusk collection at the Sapelo Island Shell ring complex, Georgia, USA using oxygen isotope Sclerochronology. *J. Archaeol. Sci.* 39, 215–228. doi: 10.1016/j.jas.2011.08.002
- Archer, G. (1998). "The description of the Now-Discovered River and country of Virginia" in *Jamestown narratives: Eyewitness accounts of the Virginia colony*. ed. E. W. Haile (Champlain, Virginia: Round House), 118–121.
- Blanton, D. B. (1992). "Observations on the middle woodland period of Virginia: a middle Atlantic region perspective" in *Middle and late woodland archaeology in Virginia: A synthesis*. eds. T. R. Reinhardt and M. E. N. Hodges (Richmond: Dietz Press), 65–96.
- Blanton, D. B., and Pullins, S. C. (2004) *Middle woodland settlement and environment in the chisel run/Powhatan Creek drainage: Archaeological data recovery at sites 44JC127 and 44JC850*. William and Mary Center for Archaeological Research, Williamsburg, Virginia.
- Blanton, D. B., Underwood, J. R., Birkett, C., and Moore, W. H. (2005) *Archaeological evaluation of eight prehistoric-native American sites at naval Weapons Station Yorktown*. William & Mary Center for Archaeological Research, Williamsburg, VA.
- Childe, V. G. (1936) *Man Makes Himself*. Watts, London.
- Custer, J. F. (1989) *Prehistoric cultures of the Delmarva Peninsula: An archaeological study*. University of Delaware Press, Newark.
- Custer, J. F. (1990). The woodland I-woodland II transition in the Delmarva Peninsula and Southeast Pennsylvania. *North Am. Archaeol.* 11, 273–287. doi: 10.2190/HKN7-TPHE-UWXX-7MDA
- Dent, R. J. (1995). "Interdisciplinary contributions to archaeology" in *Chesapeake prehistory: Old traditions, new directions* (New York: Plenum Press)
- Dunnell, R. C. (1992). The Notion Site In *Space, Time, and Archaeological Landscapes*, edited by Jaqueline Rossingnol and LuAnn Wandsnider, pp. 21–41. Springer, Boston.
- Dunnell, R. C., and Dancy, W. S. (1983). "The Siteless survey: a regional scale data collection strategy" in *Advances in archaeological method and theory* (Berkley, California: Elsevier), 267–287.
- Egloff, K. T., and Potter, S. R. (1982). Indian ceramics from coastal plain Virginia. *Archaeol. East. N. Am.* 10, 95–117.
- Feathers, J. K. (2006). Explaining Shell-tempered Pottery in Prehistoric Eastern North America. *J. Archaeol. Method Theory* 13, 89–133. doi: 10.1007/s10816-006-9003-3
- Feathers, J. K., and Peacock, E. (2008). Origins and spread of Shell-tempered ceramics in the eastern woodlands: conceptual and methodological frameworks for analysis. *Southeast. Archaeol.* 27, 286–293.
- Feinman, G. M., and Neitzel, J. E. (2023). The social dynamics of settling down. *J. Anthropol. Archaeol.* 69:101468. doi: 10.1016/j.jaa.2022.101468
- Foley, R. (1981). A Model of Regional Archaeological Structure. *Proceedings of the Prehistoric Society*. 47, 1–47.
- Gallivan, M. D. (2002). Measuring sedentariness and settlement population: accumulations research in the middle Atlantic region. *Am. Antiq.* 67, 535–557. doi: 10.2307/1593825
- Gallivan, M. D. (2011). The archaeology of native societies in the Chesapeake: new investigations and interpretations. *J. Archaeol. Res.* 19, 281–325. doi: 10.1007/s10814-010-9048-4
- Gallivan, M. D. (2016) *The Powhatan landscape: An archaeological history of the Algonquian Chesapeake*. University Press of Florida, Gainesville.
- Gardner, W. M. (1982). "Early and middle woodland in the middle Atlantic: an overview" in *Practicing environmental archaeology: Methods and interpretations*. ed. R. Moeller (American Indian Archaeological Institute: Washington, CT), 53–86.
- Garland, C. J., and Thompson, V. D. (2023). Collective action and shellfish harvesting practices among late archaic villagers of the South Atlantic bight. *J. Anthropol. Archaeol.* 69:101483. doi: 10.1016/j.jaa.2022.101483
- Hantman, J. L., and Gold, D. (2000). "The woodland in the middle Atlantic: ranking and dynamic political stability" in *The woodland southeast*. eds. D. G. Anderson and J. M. Robert C (Tuscaloosa: University of Alabama Press)
- Herbert, J. M. (2008). The history and practice of Shell tempering in the middle Atlantic: a useful balance. *Southeast. Archaeol.* 27, 265–285.
- Holmes, W. H. (1907). Aboriginal Shell-heaps of the middle Atlantic Tidewater region. *Am. Anthropol.* 9, 113–128. doi: 10.1525/aa.1907.9.1.02a00080
- Jenkins, J. A., and Gallivan, M. D. (2020). Shell on earth: oyster harvesting, consumption, and deposition practices in the Powhatan Chesapeake. *J. Island Coast. Archaeol.* 15, 384–406. doi: 10.1080/15564894.2019.1643430
- Jenkins, J. A., and Gallivan, M. D. (2022). An interdisciplinary study of woodland and protohistoric oyster harvesting in the lower Chesapeake estuary. *Current* 9, 4–5.
- Jenkins, J. A., Gallivan, M. D., and Han, E. (2023). Roast 'em, shuck 'em, stick 'em in a Stew: oyster harvesting and processing practices at a woodland and Protohistoric Village site (44YO687) in the Chesapeake. *J. Middle Atlantic Archaeol.* 39, 103–120.
- Kent, B. (1988) *Making dead oysters talk: Techniques for analyzing oysters from archaeological sites*. Maryland Historic Trust, Annapolis.
- Lansing, J. S., Cheong, S. A., Chew, L. Y., Cox, M. P., Ho, M.-H. R., and Arthawiguna, W. A. (2014). Regime shifts in balinese subaks. *Curr. Anthropol.* 55, 232–239. doi: 10.1086/675429
- Lattanzi, G., Michael Stewart, R., and Pevarnik, G. (2015) It fell from the sky: style, messaging, and information exchange in middle woodland Abbott zoned ceramics. In: Conference paper, middle Atlantic archaeological conference, Ocean City, MD.
- Lawrence, D. R. (1988). Oysters as Geoarchaeologic objects. *Geoarchaeology* 3, 267–274. doi: 10.1002/gea.3340030403
- Makin, D. (2018) Zone-decorated pots at the hatch site (44PG51): A late woodland manifestation of an ancient tradition. MA thesis Department of Anthropology, William & Mary, Williamsburg.
- Nash, C. (2020). "Middle woodland research in Virginia: a review of Post-1990 studies" in *The archaeology of Virginia's first peoples*. eds. E. A. Moore and B. K. Means (Richmond: Archeological Society of Virginia), 123–160.
- Opperman, A. F. (1992) Middle woodland subsistence at Maycock's point (44PG40), Prince George County, Virginia. MA thesis Department of Anthropology, University of Tennessee, Knoxville.
- Ostrom, E. (2002) *The Drama of the commons*. National Academy Press, Washington, DC.
- Ostrom, E. (2019) *Governing the commons: The evolution of institutions for collective action*. Canto Classics, Cambridge University Press: Cambridge.
- Potter, S. R. (1993) *Commoners, tribute, and chiefs: The development of Algonquian culture in the Potomac Valley*. University Press of Virginia, Charlottesville.
- Reeder-Myers, L., Braje, T. J., Hofman, C. A., Elliott, E. A., Smith, C. J., Garland, M. G., et al. (2022). Indigenous oyster fisheries persisted for millennia and should inform future management. *Nat. Commun.* 13:2383. doi: 10.1038/s41467-022-29818-z
- Reitz, E. J. (2014). Continuity and resilience in the Central Georgia bight fishery between 2760 BC and AD 1580. *J. Archaeol. Sci.* 41, 716–731. doi: 10.1016/j.jas.2013.10.004
- Rick, T. C., and Lowery, D. L. (2013). Accelerator mass spectrometry 14C dating and the antiquity of Shell-tempered ceramics from the Chesapeake Bay and middle Atlantic. *Am. Antiq.* 78, 570–579. doi: 10.7183/0002-7316.78.3.570
- Rick, T. C., Reeder-Myers, L. A., Hofman, C. A., Breitburg, D., Lockwood, R., Henkes, G., et al. (2016). Millennial-scale sustainability of ancient Chesapeake Bay oysters. *Proc. Natl. Acad. Sci.* 113, 6568–6573. doi: 10.1073/pnas.1600019113
- Robbins, P. (2020) *Political ecology: A critical introduction*. Wiley-Blackwell, Hoboken, New Jersey.
- Roegner, G. C., and Mann, R. (1990) *Habitat requirements for the hard clam, Mercenaria mercenaria, in the Chesapeake Bay*. Virginia Institute of Marine Science, Gloucester Point, VA.
- Rountree, H. C., Clark, W. E., and Mountford, K. (2007) *John Smith's Chesapeake voyages, 1607–1609*. University Press of Virginia, Charlottesville.
- Smith, J. (1986). "A map of Virginia" in *The complete works of captain John Smith (1580–1631)*. ed. P. L. Barbour (Chapel Hill: University of North Carolina Press), 131–177.
- Stewart, J. H. (1949). Cultural causality and law: a trial formulation of the development of early civilizations. *Am. Anthropol.* 51, 1–27. doi: 10.1525/aa.1949.51.1.02a00020
- Stewart, R. M. (1992). "Observations on the middle woodland period of Virginia: a middle Atlantic region perspective" in *Middle and late woodland archaeology in Virginia: A synthesis*. eds. T. R. Reinhardt and M. E. N. Hodges (Richmond: Dietz Press), 1–38.
- Stewart, R. M. (1998). Unraveling the mystery of zoned decorated pottery: implications for middle woodland Society in the Middle Atlantic Region. *J. Middle Atlantic Archaeol.* 14, 161–182.
- Strachey, W. (1953) *The Historie of Travell into Virginia Britania*. London: Printed for the Hakluyt Society.
- Thompson, V. D. (2018). "Collective action and village life during the late archaic on the Georgia coast" in *The archaeology of villages in eastern North America*. eds. J. Birch and V. D. Thompson (Gainesville: University Press of Florida), 20–35.
- Thompson, V. D. (2023). Considering ideas of collective action, institutions, and "hunter-gatherers" in the American southeast. *J. Archaeol. Res.* 31, 503–560. doi: 10.1007/s10814-022-09179-3



OPEN ACCESS

EDITED BY

Victor D. Thompson,
University of Georgia, United States

REVIEWED BY

Danielle Riebe,
University of Georgia, United States
Adam S. Green,
University of York, United Kingdom
Katherine Kanne,
University College Dublin, Ireland

*CORRESPONDENCE

Colin P. Quinn
✉ cpquinn@buffalo.edu

RECEIVED 23 December 2023

ACCEPTED 01 May 2024

PUBLISHED 24 May 2024

CITATION

Quinn CP (2024) Settlement ecology of
Bronze Age Transylvania.
Front. Hum. Dyn. 6:1360479.
doi: 10.3389/fhumd.2024.1360479

COPYRIGHT

© 2024 Quinn. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Settlement ecology of Bronze Age Transylvania

Colin P. Quinn*

Department of Anthropology, University at Buffalo, Buffalo, NY, United States

The Bronze Age was a time of technological, socioeconomic, and political transformation in Europe. Since Bronze Age socioeconomic institutions were rooted in the landscape, they can be investigated using a settlement ecology approach to how people positioned themselves relative to the environment and each other. Transylvania is home to a rare combination of mineral resources, trade infrastructures, and productive agropastoral land, all of which were critical to Bronze Age societies. This study combines size- and rank-size analyses to suggest that there were several shifts in how people positioned themselves across settlements in Transylvania during the Bronze Age. This research contributes to a broader understanding of the factors that inform where people choose to settle down and the consequences those decisions have on the development of social, economic, and political institutions.

KEYWORDS

Bronze Age, settlement ecology, settlement patterns, hierarchy, landscape

Introduction

The development of larger and more densely networked settlements is a key issue in archeological research (Birch, 2013; Feinman and Neitzel, 2023). Early towns were not only large settlements, but they also ushered in new types of regional relationships (Quinn and Barrier, 2018). With new forms of sedentism and aggregation came new institutions to foster interaction and decision-making (Holland-Lulewicz et al., 2020). These institutions often have consequences for the distribution of socioeconomic resources and political power within a society (Beck and Quinn, 2023).

Rather than assume a particular arrangement of social hierarchy or egalitarian systems, the relationship between people and access to key economic resources becomes the core of analyses (see Blanton and Fargher, 2008; Borgerhoff Mulder et al., 2009; Earle and Spriggs, 2015; Leppard, 2019; Smith and Coddling, 2021; Feinman and Neitzel, 2023). Drawing upon cross-cultural research, Feinman and Neitzel (2023, p. 6) have noted that key resources that were patchy or had to be acquired through trade provided opportunities for differential control and fostered greater and enduring inequalities, while horizontal ties and collective action was much more common if a community's key resources were broadly dispersed or evenly distributed. In heterogeneous landscapes, there must be diverse and alternative pathways of long-term social change. By separating the processes of sedentism and aggregation from explanations of resource extraction and distribution, archeologists can investigate how they articulate and change over time.

The Bronze Age was a time of technological, socioeconomic, and political transformation in Europe. Advances in metallurgy increased the quality and quantity of metal used for adornment items, weapons, and more mundane tools (Radivojević et al., 2019). The increased reliance upon copper and bronze helped fuel the development of interregional trade and exchange networks as people sought out mineral resources that were not locally available in

many parts of the continent (Ling et al., 2013, 2014, 2022). People ramped up trade infrastructure, including boat and ox cart technologies, to handle the increase in quantity of material being exchanged and further facilitate long-distance exchange (Van de Noort, 2004; Bondár, 2012). Communities across Europe articulated themselves to these economic networks through which metal – and a wide range of other natural resources and commodities – flowed (Earle et al., 2015). People aggregated into larger towns, including those with control over other communities as part of complex regional polities, which required new socioeconomic institutions to ensure access to resources, social cohesion, and safety (Gogâltan and Sava, 2010; Szentmiklosi et al., 2011; Gogâltan et al., 2019).

These socioeconomic transformations were neither unidirectional nor universal across the continent. Understanding how, when, and where complex regional polities emerged in the Bronze Age has been a fertile area for archeological research (Gilman, 1981; Hanks and Linduff, 2009; Earle and Kristiansen, 2010; Duffy, 2014; O'Shea and Nicodemus, 2019; Gyucha and Parkinson, 2022; Laabs, 2023). The fitful process by which inequality was institutionalized within a broader social hierarchy was as variable as the cultural practices and landscapes across the continent. For example, Nicodemus (2014, 2018) has argued for elite-controlled specialized production of horses at Pecica-Santul Mare, which Kanne (2022) has shown co-occurs with forms of equestrianism and political authority that were dispersed more broadly and less hierarchically across the Carpathian Basin. Tell-building traditions and their settlement systems in the Carpathian Basin were likewise highly variable and followed different regional trajectories (Duffy, 2014; Kienlin et al., 2017; Kienlin, 2018; Lie et al., 2019). Settlements and settlement systems were considerably diverse in terms of their site layout, size, and location (Găvan and Kienlin, 2021). Consequently, Bronze Age Europe can best be described as a multi-scalar mosaic: where local histories and landscape affordances shaped and were shaped by larger-scale political, social, and economic networks.

Bronze Age socioeconomic institutions were rooted in the landscape, making them accessible through a settlement ecology approach. Settlement ecology seeks to explain the choices people made regarding where to live as they are mediated through historically and geographically contingent factors (Stone, 1996; Jones, 2010). Within a settlement ecology approach, settlement patterns are considered the product of people's interaction with dynamic natural and cultural landscapes (Stone, 1996; Jones, 2010, 2017; Jones and Ellis, 2016; Kellett and Jones, 2017; Quinn et al., 2022). Settlement ecological approaches center human-environment interaction and avoid the pitfalls of the older "ecosystem approach" (see Brumfiel, 1992) by highlighting human agency and creating an interpretive structure where groups of actors can create transformative change. These approaches are part of a broader effort to understand the relationship among the landscape, socioeconomic organization, and human decision-making and their effects on settlement patterns and culture change (McClure et al., 2009; Jazwa and Jazwa, 2017; Weitzel and Coddling, 2022).

Kellett and Jones (2017, p. 3) have identified the core question in archeological applications of settlement ecology: "why do people settle in a given place during a specific time and in a particular arrangement?" This question can be divided into two themes within settlement ecological studies: (1) where people position themselves in space, and (2) how people arrange themselves into communities and

broader settlement systems. How people position themselves in space can be investigated through assessments of site location and how people prioritize their settlement locations relative to key resources and topographic features in the landscape (see Quinn and Ciugudean, 2018; Quinn et al., 2020b). How people arrange themselves across settlement systems can be investigated through assessments of how population was spread across a settlement network. In this study, I use site-size and rank-size analyses to characterize settlement patterns in southwestern Transylvania, and trace how they change over the course of the Bronze Age. The multiple changes in the settlement ecology of Bronze Age communities in Transylvania necessitated changes in socioeconomic institutions for the procurement, distribution, and consumption of metal and other key resources in this resource-rich landscape.

Transylvania during the Bronze Age

The Transylvanian Bronze Age is divided into three broad phases (Early, Middle, and Late), each of which is further divided into subphases often associated with different archeological cultures (see Boroffka, 1994; Ciugudean and Gogâltan, 1998; Ciugudean and Quinn, 2015; Bălan et al., 2018; Quinn et al., 2020a). The analyses in this study trace settlement patterns in southwest Transylvania across the Early Bronze Age [EBA I (2700–2500 BCE), EBA II (2500–2250 BCE), EBA III (2250–2000 BCE)], the Middle Bronze Age [Formative Wietenberg (2000–1875 BCE), Classical Wietenberg (1875–1500 BCE)], and the beginnings of the Late Bronze Age [Terminal Wietenberg (1500–1320 BCE)]. The Late Bronze Age is marked by the movement of Noua culture communities from the Eurasian Steppe into Transylvania.

Southwest Transylvania stands out as providing a rare combination of natural resources, trade infrastructures, and agropastoral productivity, all of which were critical to the social, economic, and political institutions of Bronze Age societies. Bronze Age subsistence was rooted in agropastoral economies centered on domesticated plants, like wheat and barley, and animals like pigs, sheep, goats, cattle, and eventually horses (Ciută, 2012; Nicodemus, 2018). Wild resources were also an important part of Bronze Age foodways, including fish, mussels, small game like rabbits, and large game like red deer. Domesticated animals provided not only meat, but also secondary food products like milk and cheese, other important secondary products like wool, and labor for farming and transportation (Sherratt, 1983; Kanne, 2022). Agropastoral economies required fertile land to farm as well as productive areas for pasture.

The Apuseni Mountains are home to the largest gold deposits in Europe, which – along with significant deposits of copper – were valuable minerals in the Bronze Age (Boroffka, 2006; Ciugudean, 2012; Beck et al., 2020). There are significant salt springs and rock salt deposits at the margins where the Transylvanian Plateau meets the foothills of the Apuseni and Carpathian Mountains (Harding and Kavruk, 2013). The Mureș River and its terraces provides an important corridor for trade and exchange by boat, ox cart, or foot (Bondár, 2012). This river connects the rolling hills in the heart of Transylvania to the east to the Carpathian Basin and ultimately the Tisza and Danube Rivers to the west (O'Shea, 2011). There would have been abundant forests at the start of the Bronze Age that could have provided the fuel for their fiery technologies like ceramic production and metallurgy. Forests would also have provided refugia for wild game which could be hunted. Pasture, both in the Apuseni uplands and the Mureș floodplain could

have supported domesticated animals. The broad terraces along the Mureș and the lower portions of the mountain valleys would have been ideal for Bronze Age agriculture. Together, this bountiful landscape had the resources to support growing populations and potentially fuel the emergence of more hierarchically-organized polities.

Applying a settlement ecological approach to Bronze Age Transylvania

The socioeconomic institutions of Bronze Age Transylvania were mediated through the environment. In a prior study of settlement placement in southwest Transylvania, my colleague and I used catchment analyses to explore the economic priorities of Bronze Age communities (see Quinn and Ciugudean, 2018). These catchment analyses suggested that EBA I communities were situated in the landscape with minimal consideration of accessing particular resources in local catchments. Throughout the Bronze Age, communities did not prioritize access to metal ores; perhaps surprising given their abundance and economic importance to all Bronze Age societies. Starting with the EBA II and continuing through the Terminal Wietenberg, communities prioritized access to agricultural land and interregional trade routes along the Mureș River corridor. With the start of the MBA, there was a diversification among the catchments in which the largest settlements were placed, suggesting that different large Wietenberg communities may have engaged in different socioeconomic strategies to grow and support their populations.

Catchment analyses of mortuary sites in southwest Transylvania have shed light on the roles of symbolic landscapes as part of a broader settlement ecology (Quinn et al., 2020b). During the Early Bronze Age, people placed their dead in highly visible cemeteries in the metal-rich mountain landscapes. This prioritization of metal-rich land for Early Bronze Age cemeteries stands in stark contrast to settlement placement, which did not prioritize these landscapes. By the Middle Bronze Age, however, most burials were placed in flat cemeteries near settlements. These cremation cemeteries were not in metal-rich landscapes, and instead were situated near interregional trade routes and good agricultural land.

These prior studies have emphasized an important aspect of settlement ecology: where people chose to place their settlements and cemeteries relative to economic resources in a heterogeneous landscape. How people in Transylvania positioned themselves relative to others is another important aspect of Bronze Age settlement ecology. People may have prioritized access to key socioeconomic hubs within a region, which may have resulted in some settlements growing significantly larger than others. Alternatively, people may have prioritized autonomy and separation from each other. While site location is a choice made at the initial founding of a settlement, population growth, aggregation, and depopulation are all processes that take place over longer periods of time. This issue, however, requires additional analyses.

Site-size and rank-size analyses and Bronze Age Transylvanian settlement ecology

The way people position themselves relative to each other will affect the size of settlements. Settlement site-size distributions have

been an important line of evidence to identify the presence of complex regional polities in middle-range societies in Europe (see Gilman, 1981; Némethi and Molnár, 2002, 2012; Kristiansen and Larsson, 2005, pp. 125, 158; Earle and Kristiansen, 2010; Duffy, 2015). The presence of site-size hierarchies, defined as a settlement pattern composed of many small sites and few large sites (Duffy, 2015, p. 85), may indicate the presence of regional centralization of political authority – the emergence of a political system with a central chief or chiefly lineage situated in the large regional center and exerting political control or influence over surrounding, small, settlements. However, there are several alternative processes that can produce a settlement site-size hierarchy as recovered by archaeologists without complex regional polities, including fission-fusion models (Blitz, 1999), differences in catchment productivity, and seasonal or special purpose aggregations (also see Flannery, 1976; Crumley, 1979; Parkinson, 2002; Galaty, 2005; Peterson and Drennan, 2011; Duffy, 2015; Quinn and Barrier, 2018). There are key demographic thresholds when population density and the sizes of interactive networks create strains on social institutions (Feinman and Neitzel, 2023). In these contexts, people may invent new communally-integrative institutions to avoid fissioning, with varying degrees of success (Bandy, 2004). As these alternative processes affect site size and placement, settlement site-size distributions are but one of the several archaeological measures used to identify the presence of and the mechanisms involved in the emergence of site-size hierarchies.

Rank-size analyses are another method to characterize how people were distributed across the landscape using site-size as a proxy for population. In general, rank-size analyses should be able to assess if populations distributed across different settlements matched expectations for more autonomous village societies (with sites of a similar size) or hierarchical community organization (with one large primate center and many smaller sites). Rank-size analyses are based on a null-model of a log-normal site size distribution; the expectation that the second largest settlement (rank = 2) should be half as large as the largest settlement (rank = 3), the third largest settlement (rank = 3) should be half as large as the second largest settlement, and so on (Zipf, 1949; Drennan and Peterson, 2004, p. 533).

The Bronze Age Transylvania Survey (BATS) Project has compiled a comprehensive dataset of Bronze Age settlements in Alba County, Romania (Figure 1). At the county level, broad chronological and cultural affiliations for each settlement are assessed based on ceramic styles. The BATS Project complemented this extensive dataset with intensive pedestrian survey, test excavation, and radiocarbon dating of Bronze Age sites in the Geoagiu Valley, a key corridor connecting the fertile Transylvanian lowlands and the metal-rich Apuseni Mountains (Figure 2).

Site sizes in southwest Transylvania were estimated in two ways. In most cases, site extents were determined through pedestrian survey as part of the BATS Project. At the few sites with more intensive archaeological research, site sizes were derived from published site maps. For several phases (especially EBA I and EBA III), there are only a few sites with recorded site sizes. It is important to note that for many multi-component sites, it is not clear how settlement size changed through time (if population grew, shrunk, or stayed constant; if settlement moved to create a large cumulative footprint). As a result, sites were omitted from this analysis if the size of a particular component was significantly overestimated by the overall size of the

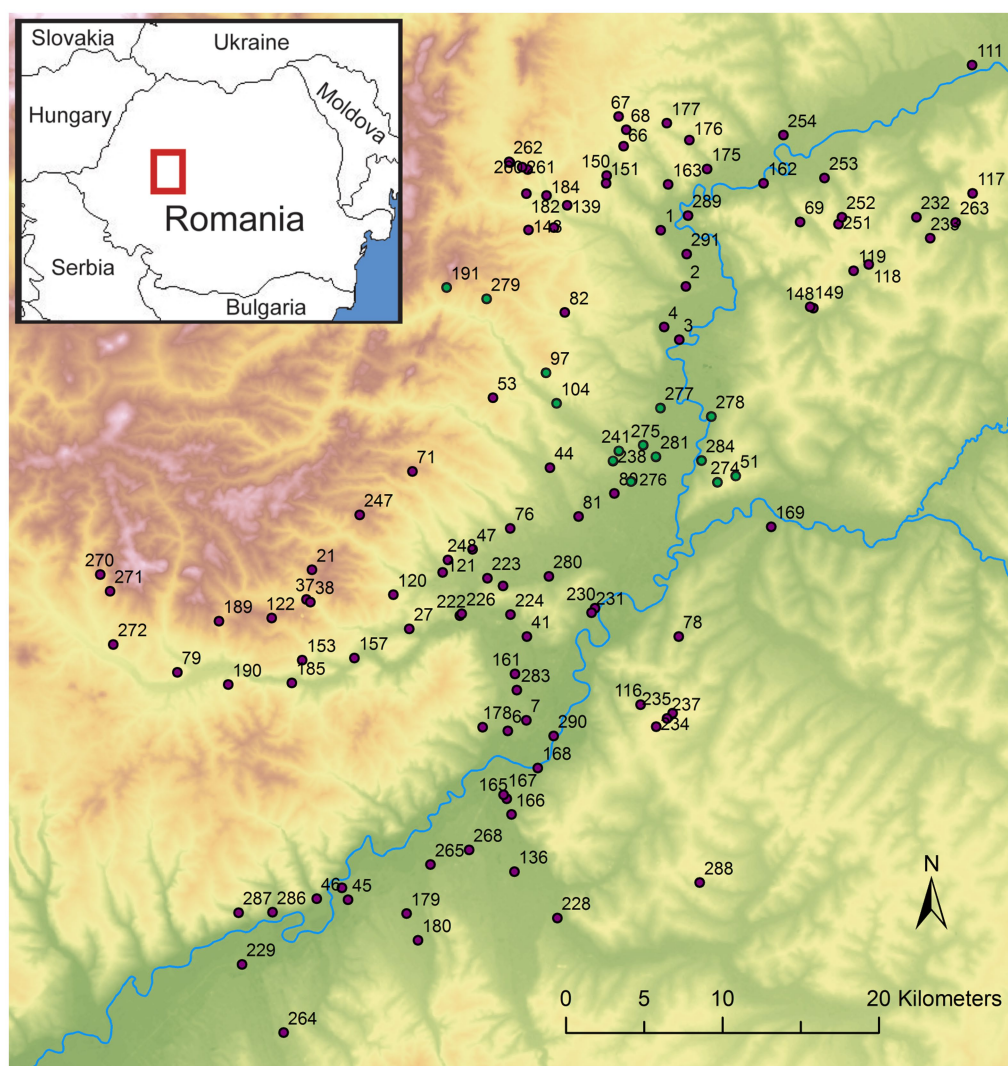


FIGURE 1
Map of Bronze Age settlements in southwest Transylvania (Geoagiu Valley region sites marked with green dots).

site. These issues can only be resolved with significantly more survey and sub-surface testing.

For each Bronze Age phase, the settlement system was characterized by the coefficient A developed by Drennan and Peterson (2004). The A -coefficient measures deviation from the ideal rank-size distribution (a negative linear relationship between the log-normal distribution of site sizes and log-normal distribution of settlement rank), with a primate distribution expected (A = negative) in settlement patterns with a large regional center and a convex distribution expected (A = positive) in settlement patterns that lack a significant regional hierarchy (Figure 3).

The A -coefficient is a useful tool because it facilitates comparisons between two or more observed patterns (such as time periods) (Drennan and Peterson, 2004, p. 535). The comparative potential of the A -coefficient is important because of the shortcomings in the southwest Transylvanian regional dataset. Most biases in the dataset, such as an underrepresentation of small sites due to the lack of a systematic pedestrian and geophysical survey program at the county

level, are consistent across all time periods. The rank-size model is also sensitive to the presence of multiple polities within a region – where the second ranked site in the region, similar in size to the first ranked site, will result in a convex distribution (positive A -coefficient) though each individual polity may fit a primate or log-normal distribution. As such, the overall A -coefficient value and its association with log-normal, primate, and convex distributions are less important than monitoring when, and in how, settlement systems in Bronze Age southwest Transylvania underwent qualitative and quantitative changes.

Results

In this section, I present the results of analyses first at the regional scale across southwest Transylvania (Alba County), then at the microregional scale within the Geoagiu Valley. Of the 108 known sites associated with the six Bronze Age subphases in this study, there are 40 sites with site-size estimates in Alba County. These settlements

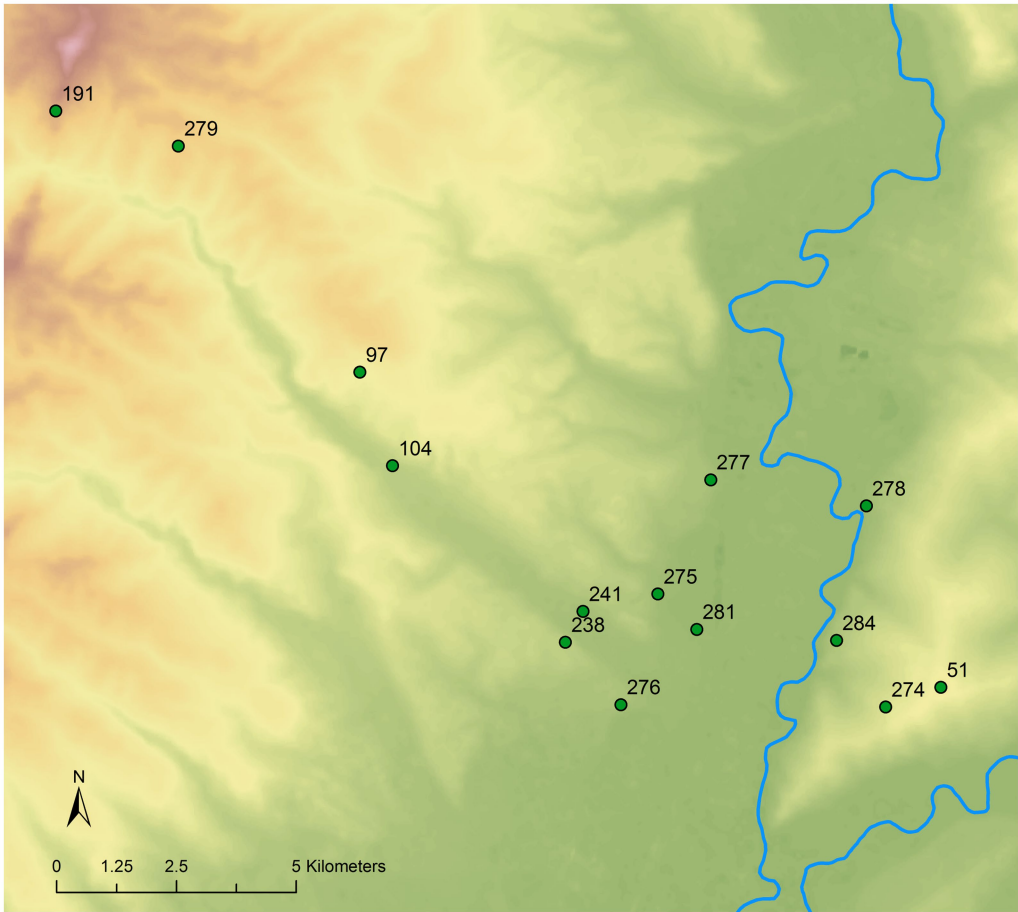


FIGURE 2
Map of settlements in the Geoagiu Valley region.

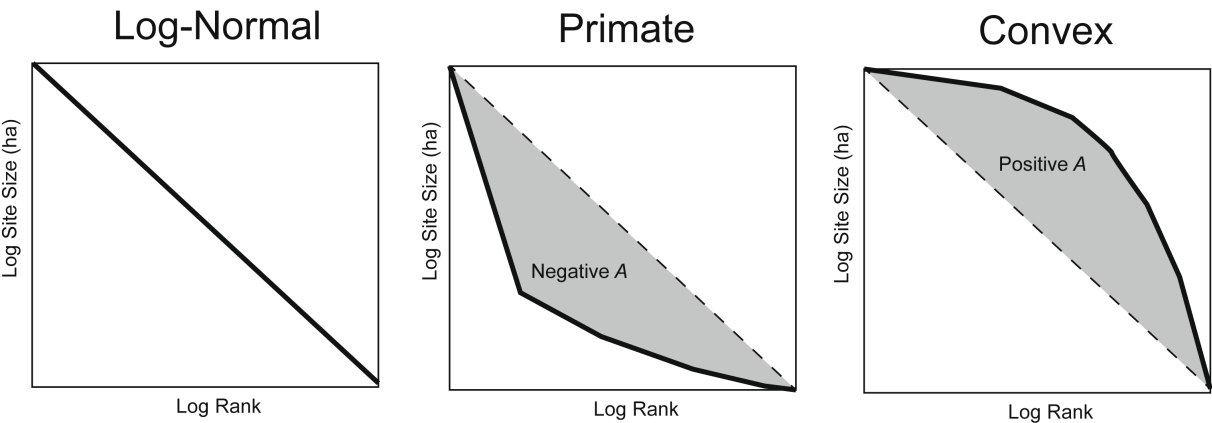


FIGURE 3
Potential distributions of rank-size model. Log-normal and primate distributions are more consistent with hierarchical settlement systems while convex distributions are more consistent with more horizontally integrated settlement systems. The shaded area represents the deviation from the log-normal distribution measured through the A-coefficient.

range from less than a hectare to nearly 9 hectares in size (Figure 4). The sites can be classified into three ordinal size categories: small sites (up to 3 ha), medium-sized sites (3–6.5 ha), and large sites (6.5–9 ha). Of the 40 sites, 28 are small (70%), 9 are medium-sized (22.5%), and 3 are large (7.5%).

EBA I: southwest Transylvania site and rank-size analysis

Only 5 of 14 sites (35.7%) from EBA I (2700–2500 BCE) have site size estimates (Table 1). All five sites are classified as small sites (under

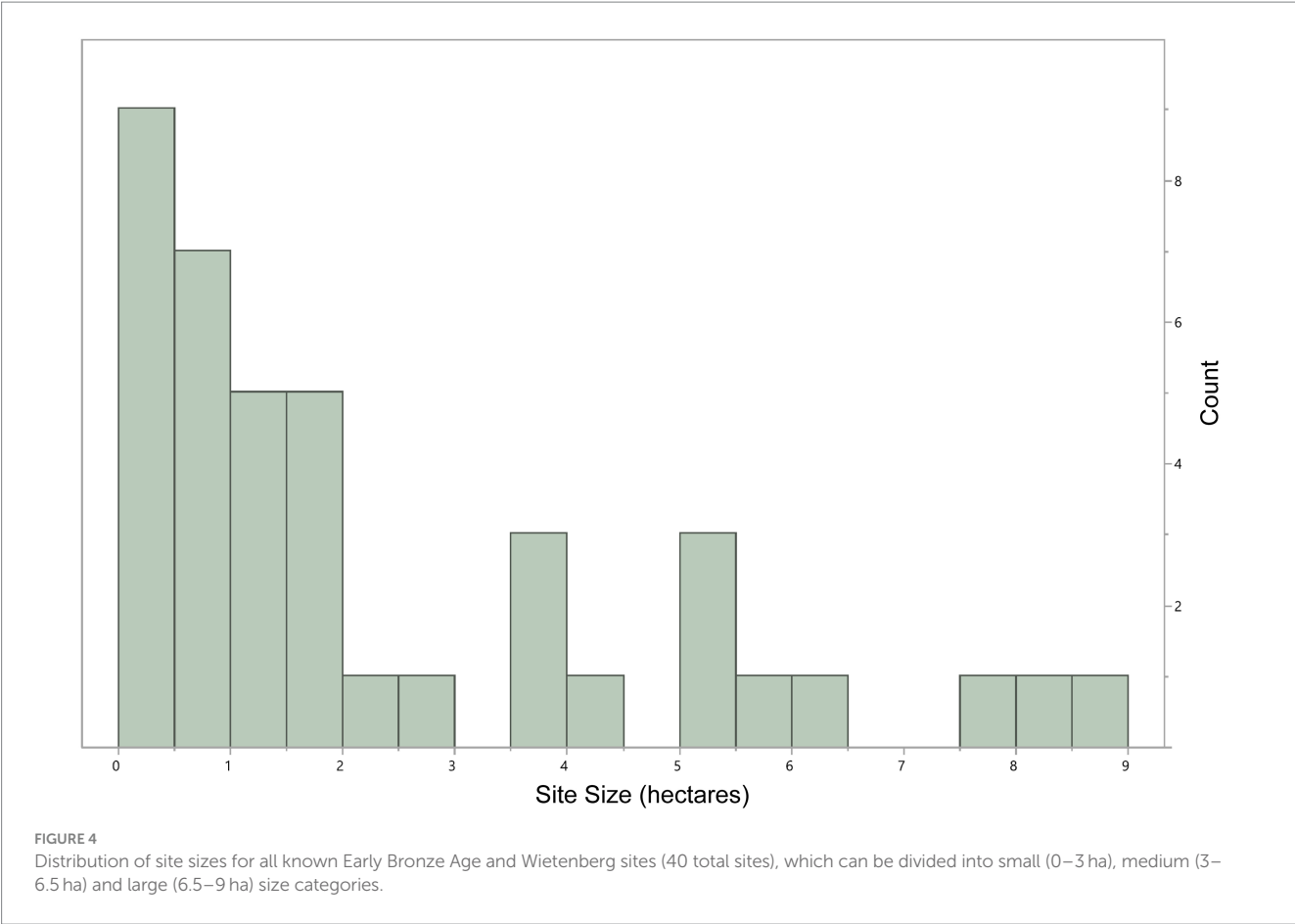


TABLE 1 EBA I site sizes.

ID	Site name	Site size (ha)
51	Capud-Măgura Capudului	0.16538021759
137	Livezile-Baia	0.84512416841
185	Poiana Ampoiului-Piatra Corbului	0.10056771773
231	Sântimbru-Obreje/La Tabaci	2.56340003994
279	Rameț-Gugului	0.15882737526

3 hectares). The rank-size graph is close to a primate distribution ($A = -1.032$), which is normally associated with a single large site and many small sites (Figure 5). In this case, the largest site is Sântimbru-Obreje/La Tabaci, which is only 2.56 ha in size. This site is also occupied during the EBA II, and it is currently unclear if the total area of the site was fully occupied continuously through these two periods, or if the overall site size was produced through two smaller and mostly spatially distinct (though overlapping) occupations.

EBA II: southwest Transylvania site and rank-size analysis

A substantial portion of known EBA II sites, 15 of 21 (71.4%), have site size estimates (Table 2). All 15 sites are classified as small sites (under 3 hectares). The rank-size graph matches a convex distribution

($A = 0.417$), which is normally associated with a settlement pattern without a large regional center (see Figure 5). The largest site is Sântimbru-Obreje/La Tabaci, which is only 2.56 ha in size.

EBA III: southwest Transylvania site and rank-size analysis

Just under half of the sites with EBA III components, 5 of 11 (45.5%) have site size estimates (Table 3). Four sites (80.0% of EBA III sites) are classified as small sites (under 3 hectares), and one site (20.0% of EBA III sites) is classified as medium-sized (between 3 and 6.5 hectares). The rank-size graph most closely matches a log-normal distribution ($A = 0.097$) associated with the presence of a site-size hierarchy (see Figure 5). The largest site is Oarda de Jos-Sesul Orzii, which is 3.77 ha in size.

Formative Wietenberg: southwest Transylvania site and rank-size analysis

In southwest Transylvania, 8 of 14 settlements (57.1%) of Formative Wietenberg sites (sites with Wietenberg Type A ceramics) have site size estimates (Table 4). While some sites with Wietenberg Types B and C ceramics may date to the second half of the formative Wietenberg, they are omitted from this analysis because they cannot be attributed to the Formative Wietenberg without radiocarbon dates. Four of the sites (50.0% of Formative Wietenberg sites) are classified as small sites

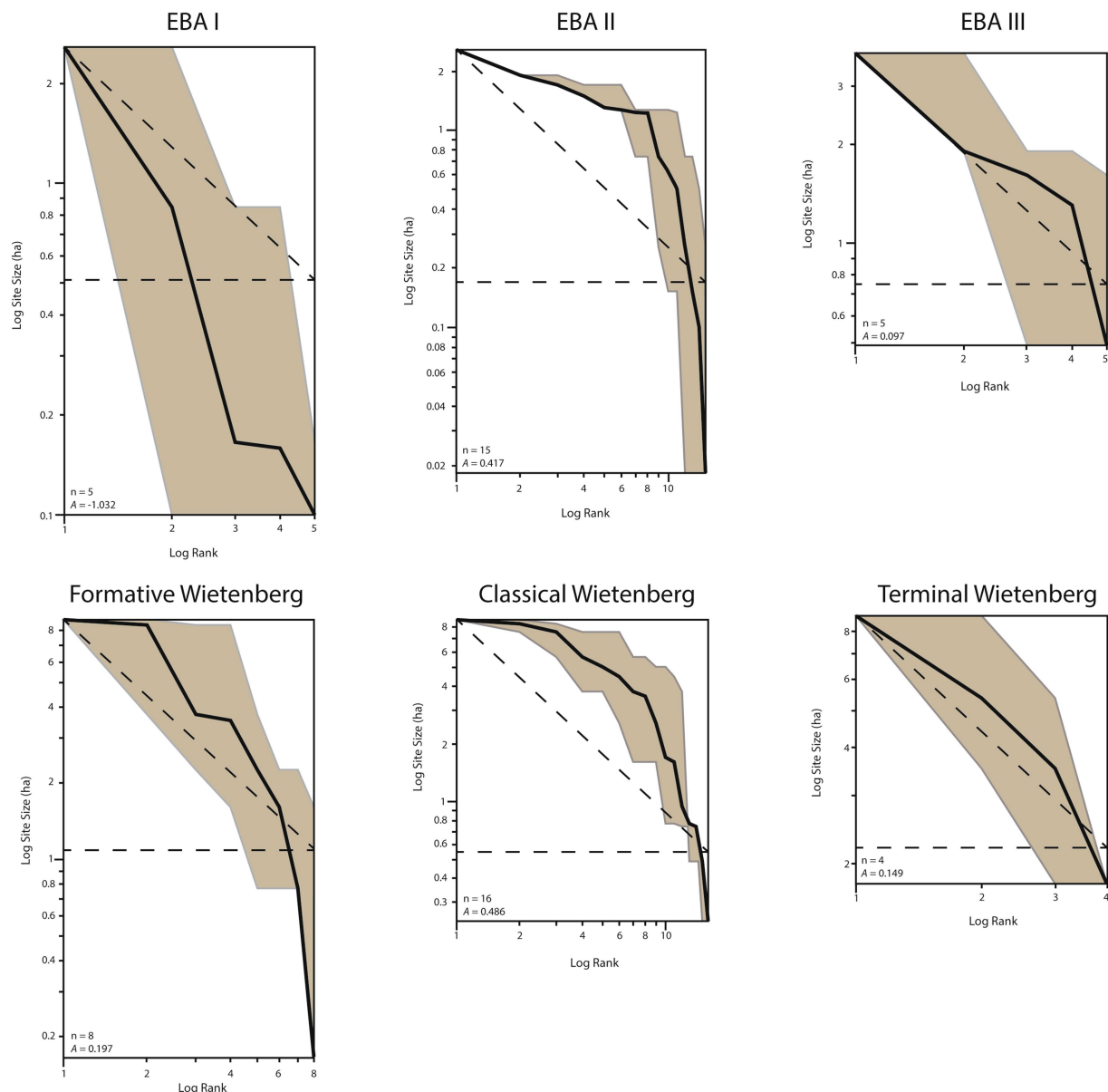


FIGURE 5

Rank-size plot of settlement networks for each Bronze Age subphase in southwest Transylvania. Shaded area is the approximate 90% confidence zone for rank-size curve.

(under 3 hectares), two sites (25.0% of Formative Wietenberg sites) are classified as medium-sized (between 3 and 6.5 hectares), and two sites (25.0% of Formative Wietenberg sites) are classified as large sites (over 6.5 hectares). The rank-size graph is slightly concave ($A = 0.197$), which is normally associated with a settlement pattern without a large regional center (see Figure 5). The largest sites are Pețelca-Cascadă (8.81 ha) and Alba Iulia-Recea/Monolit (8.40 ha), which may represent two distinct regional centers within southwest Transylvania.

Classical Wietenberg: southwest Transylvania site and rank-size analysis

Of the sites that may be from the Classical Wietenberg Phase, 19 of 44 (43.2%) have site size estimates (Table 5). Nine of the sites (47.4% of Classical Wietenberg sites) are classified as small sites (under 3 hectares), five sites (36.8% of Classical Wietenberg sites) are classified as

medium-sized (between 3 and 6.5 hectares), and three sites (15.8% of Classical Wietenberg sites) are classified as large sites (over 6.5 hectares). The rank-size graph matches a concave distribution ($A = 0.486$), which is normally associated with a settlement pattern without a large regional center (see Figure 5). The largest sites are Pețelca-Cascadă (8.81 ha) and Alba Iulia-Recea/Monolit (8.40 ha), which may represent two distinct regional centers within southwest Transylvania. The third large site, Micești-Cigaș covers 7.61 ha though it is a single component site (cultural deposits <20 cm in depth) unlike the deeply stratified sites of Pețelca-Cascadă and Alba Iulia-Recea/Monolit.

Terminal Wietenberg: southwest Transylvania site and rank-size analysis

Unfortunately, there are no Wietenberg ceramic styles that are temporally diagnostic of the Terminal Wietenberg period. As a result,

TABLE 2 EBA II site sizes.

ID	Site name	Site size (ha)
3	Aiud-Cețățuie	1.70097152625
37	Ampoița-Pestera Liliecilor	0.01841217094
97	Geoagiu de Sus-Fântâna Mare	1.22602725922
148	Lopadea Nouă-Cețățuie 1	0.15308960391
162	Micoșlaca-(no name)	0.61200839248
167	Oarda de Jos-Dublihan	1.30524874187
175	Ormeniș-(no name)	1.27178793783
185	Poiana Ampoiului-Piatra Corbului	0.10056771773
222	Șard-(no name)	0.25571287703
224	Șard-Bilag 2	1.23366949248
231	Sântimbru-Obreje/La Tabaci	2.56340003994
238	Stremț-Berc 1	0.50500452220
274	Capud-(no name)	0.73690801085
276	Teiuș-Coastă	1.90392247900
277	Gârbova de Jos-În Coastă	1.49381786954

TABLE 3 EBA III site sizes.

ID	Site name	Site size (ha)
136	Lancrâm-Glod	1.60842068679
167	Oarda de Jos-Dublihan	1.30524874187
168	Oarda de Jos-Sesul Orzii	3.77049409628
252	Uioara de Jos-La Gruii/ Gruii lui Sip	0.49037463410
276	Teiuș-Coastă	1.90392247900

TABLE 4 Formative Wietenberg site sizes (Wietenberg type A).

ID	Site name	Site size (ha)
6	Alba Iulia-Recea/Monolit	8.39894596661
51	Capud-Măgura Capudului	0.16538021759
68	Cicău-Săliște	0.77017743637
97	Geoagiu de Sus-Fântâna Mare	3.53158315546
136	Lancrâm-Glod	1.60842068679
230	Sântimbru-La Tarmure/La Ieruga	2.25637342921
241	Stremț-Fabrica de Alcool	3.73152474901
278	Pețelca-Cascadă	8.80784618233

this site-size analysis is limited to sites within the Geoagiu Valley that have been more intensively studied and dated. There are 4 sites that date to the Terminal Wietenberg with site size estimates (Table 6). One of the sites is classified as a small site (under 3 hectares), two sites are classified as medium-sized (between 3 and 6 hectares), and one site is

TABLE 5 Classical Wietenberg site sizes (Wietenberg types B, C, and D).

ID	Site name	Site size (ha)
3	Aiud-Cețățuie	1.70097152625
6	Alba Iulia-Recea/Monolit	8.39894596661
41	Bărbant-(no name)	5.64303043924
68	Cicău-Săliște	0.77017743637
78	Dumitra-(no name)	0.23990372724
97	Geoagiu de Sus-Fântâna Mare	3.53158315546
104	Geoagiu de Sus-Viile Satului	0.94546110990
136	Lancrâm-Glod	1.60842068679
161	Micești-Cigaș	7.61207839661
176	Ormeniș-Cânepiște/ Cânepi/La Pod	0.74368708325
230	Sântimbru-La Tarmure/La Ieruga	5.01268083627
241	Stremț-Fabrica de Alcool	3.73152474901
251	Uioara de Jos-Îtardeau/La Parloage	0.17426187250
252	Uioara de Jos-La Gruii/ Gruii lui Sip	0.49037463410
278	Pețelca-Cascadă	8.80784618233
280	Oieidea-Bilag 1	4.46265270622
286	Acmaru-Școală	5.073918
287	Acmaru-Valea Feneșului	1.644249
288	Șpring-Cătun Carpen	6.188635

classified as large sites (over 6 hectares). The rank-size graph is slightly concave ($A = 0.149$), which is normally associated with a settlement pattern without a large regional center (see Figure 5). The largest site is Pețelca-Cascadă (8.81 ha).

Geoagiu Valley site-size analysis

In the Geoagiu Valley, where several sites have been investigated through test excavations, it is possible to use radiocarbon dates to develop a fine-grained record of settlement history within the valley (Figure 6). However, not all settlements have been dated. For example, dates are not available for Early Bronze Age occupations at Stremț-Berc 1, Capud-No name and Ramet-Gugului. The site-size hierarchy within the settlement system fluctuated throughout the Middle Bronze Age and early Late Bronze Age in the Geoagiu Valley. For the majority of the Early and Middle Bronze Ages, only one or two tiers of settlement sizes were contemporaneously occupied. With the introduction of Noua communities in the LBA, Wietenberg communities reorganized and were characterized by a three-tier settlement hierarchy for the first time. This new settlement configuration was brief, as it, as well as the Wietenberg Culture in southwest Transylvania, collapsed after 100–150 years (by 1320 BCE).

TABLE 6 Terminal Wietenberg site sizes (sites in Geoagiu Valley).

ID	Site name	Site size (ha)
97	Geoagiu de Sus-Fântâna Mare	3.53158315546
191	Rameț-Curmatura	1.77010882695
275*	Teiuș-Fântâna Viilor	5.38294906406
278	Petelca-Cascadă	8.80784618233

*Noua culture site with some Wietenberg ceramics.

Discussion

The broad trajectory of site- and rank-size analyses provides a divergent picture of Bronze Age Transylvanian settlement systems. There is a general trend toward an increase in the frequency of large sites throughout the Bronze Age in southwest Transylvania (Figure 7). In EBA I and EBA II, all sites are below 3 ha in size. In EBA III, one settlement (Oarda de Jos-Sesul Orzii) was over 3 ha. By the start of the Middle Bronze Age (Formative Wietenberg), people agglomerated into large towns (over 8 ha). This general pattern of multiple contemporaneously occupied large sites within the region continued throughout the rest of the Middle Bronze Age (Classical Wietenberg) and into the Late Bronze Age (Terminal Wietenberg).

In contrast, rank-sized analyses do not indicate a general or consistent shift toward a pattern of settlement hierarchy during the Bronze Age in Transylvania (Figure 8). EBA I pattern fits a more primate distribution. While all sites are considered small, one site (Sântimbru-Obreja/La Tabaci) is significantly larger than the rest. The EBA II settlement pattern more closely fits a concave distribution. The beginning of the EBA III saw a shift back toward a log-normal distribution. With the start of the Formative Wietenberg, and continuing with the Classical Wietenberg, settlement distributions became slightly more concave. The concave distribution in the Middle Bronze Age, despite the emergence of large sites is in part due to the presence of multiple large sites in southwest Transylvania (Alba Iulia-Recea/Monolit; Petelca-Cascadă; Micești-Cigaș). Of these, Alba Iulia-Recea/Monolit and Petelca-Cascadă are stratigraphically deep as well as horizontally large. If these two large sites represent central settlements within an integrated network, then it is likely that there were at least two networks in southwest Transylvania during this time.

Together, the size- and rank-size analyses suggest that there were three major shifts in how people positioned themselves across settlements during the Bronze Age. First, from EBA I to EBA II, people were dispersed more evenly across settlements. Second, from EBA III to the Formative Wietenberg, people began to aggregate in larger settlements. The settlement dynamics in the Geoagiu Valley reveal fission-fusion and rapid settlement shifts among Wietenberg communities. Third, and finally, from the Classical Wietenberg to Terminal Wietenberg, a three-tier site size hierarchy was established in the Geoagiu Valley. After the arrival of Noua communities into the region, Wietenberg communities increased the amount of archaeologically visible activity (settlement and ritual deposition) in the high mountain passes that connect the lowland Mureș River Valley and the richest metal deposits in the region (see Quinn et al., 2020a). This configuration ultimately collapsed within 180 years as Transylvanian communities ultimately abandoned Wietenberg cultural identities during the Late Bronze Age. As seen in other

regions in the Carpathian Basin (see Duffy, 2014, 2015), the presence of a site-size hierarchy in Transylvania is not definitive evidence of the presence of regional polities during the Bronze Age. Future work to document the sizes of other Bronze Age sites in the region would strengthen confidence in the patterns identified in this study.

The settlement ecology of Bronze Age Transylvanian communities connects how people positioned themselves relative to each other and to resources in the landscape. Throughout the Bronze Age, people's strategies for when to aggregate, when to abandon settlements, and when to spread across the landscape varied significantly. At the start of the Early Bronze Age, the community at Sântimbru-Obreja/La Tabaci was larger than the rest, though it was still a small settlement. Most communities were more evenly spread across the landscape as people positioned themselves in locations where they could grow sufficient food for their communities and gain access to growing interregional trade routes.

By the Middle Bronze Age, the large regional centers, like Alba Iulia-Recea/Monolit and Petelca-Cascadă, were consistent draws for a more continuous form of occupation, while the smaller village sites appear to have had shorter life-histories. Residents of smaller communities abandoned these sites more often, and while some people may have moved into the larger towns, it is likely that these communities established new smaller settlements in a different part of the landscape. There is currently no evidence that larger communities fissioned due to population density pressures. The persistence of larger towns may owe to their strategic positioning in highly productive catchments or along the primary interregional trade route (see Quinn and Ciugudean, 2018). The increased residential mobility of smaller communities may be linked to local depletion of resources, such as lumber and ore, that were important for craft production. Rather than find new ways of mobilizing resources to these settlements, as they would have for the larger towns, the communities decided to abandon the settlement and establish a new one with more easy access to key economic resources that were unevenly distributed across the Transylvanian landscape. For residents of the larger centers, the socioeconomic benefits of their strategic positioning likely offset the costs of transporting raw materials and food from increasingly distant locations into the settlement. This may have created political economic bottlenecks and opportunities for emerging elites to exert control (see Earle and Kristiansen, 2010; Earle et al., 2015). However, it may also have been a collective action problem that could have been mediated through cooperation without need of centralized control (see Carballo et al., 2014). In either case, all townspeople found reasons to aggregate and stay, such as seeking safety in numbers, potential access to ritual spaces, and more direct access to broader economic and social networks (see O'Shea and Nicodemus, 2019).

The arrival of migrant communities in the Late Bronze may have spurred new forms of competition for access to the critical natural resources (e.g., copper, gold, salt) in Transylvania. There is currently no evidence of direct violence between these communities, but the increased intensity of occupation of high elevation locations and ritual deposition at key mountain passes by Wietenberg communities may indicate indirect competition with Noua communities. This new regime of situating settlements indicates a shift in the settlement ecology of Terminal Wietenberg communities to prioritize securing access to metal ores that were only previously seen in the placement of Early Bronze Age burial mounds.

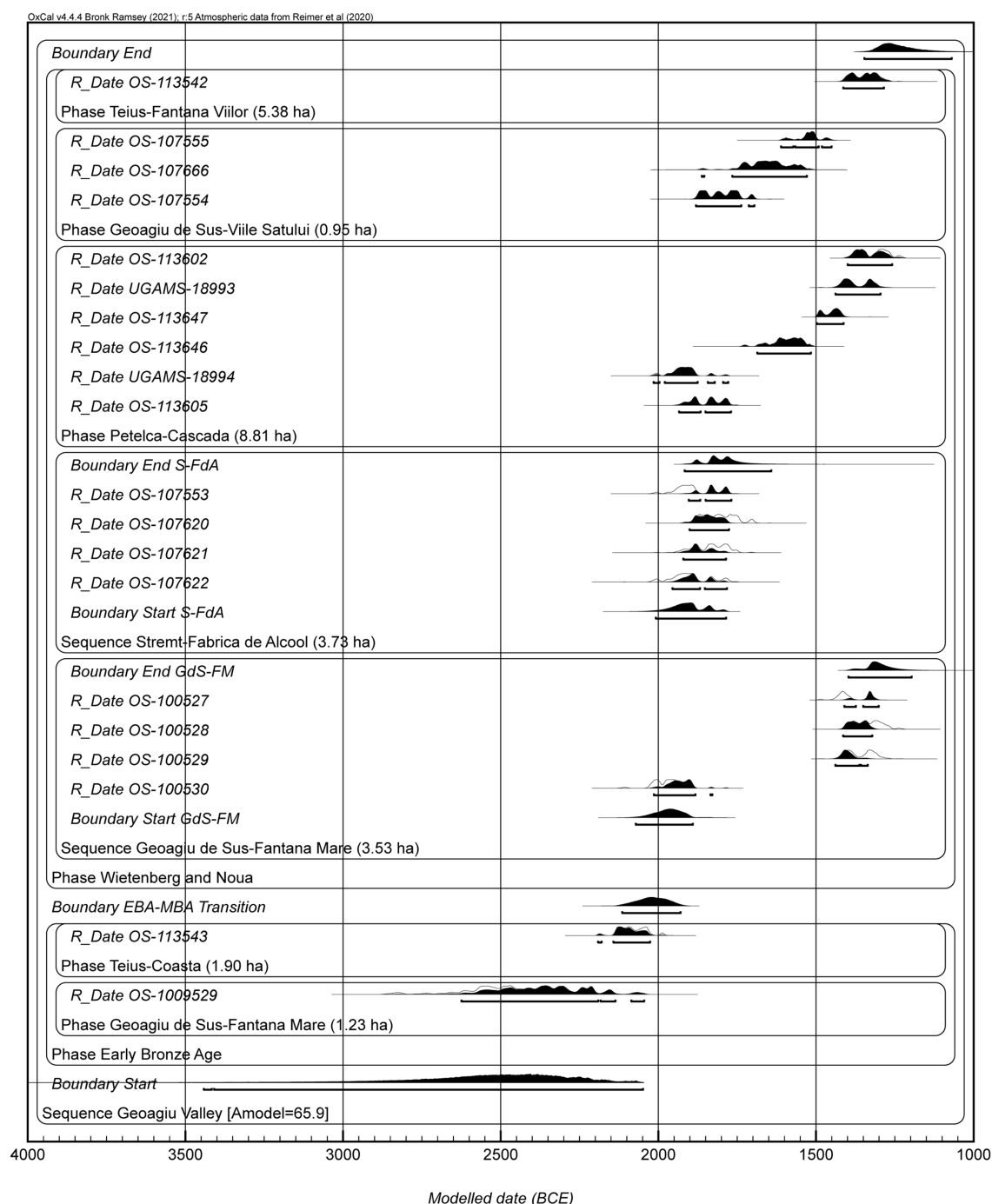


FIGURE 6

Bayesian model of dated Bronze Age sites in the Geoagiu Valley with site sizes.

The patterns from southwest Transylvania fit within an emerging view of regional diversity in the trajectories of wealth inequality and political centralization in the European Bronze Age. In southeast Transylvania, [Dietrich \(2010, 2014\)](#) has argued for the presence of more hierarchical polities during the Middle Bronze Age based on hilltop fortified as sites that were elite-controlled centers that dominated the landscape. Alternatively, [Puskás \(2018\)](#), drawing upon [Boroffka \(1994\)](#), has suggested that these fortified hilltop sites may have been temporary refuges, though not fully discounting their

potential link to emergent political elite. New radiocarbon dates from southeast Transylvania support the suggestion that the trajectories of Bronze Age societies in that region may have differed from those in southwest Transylvania (see [Quinn et al., 2020a](#); [Puskás et al., 2023](#)). To the northwest of Transylvania in the Upper Tisza region, [Kienlin et al. \(2017, p. 118\)](#) have argued that the organization of social space was informed by concerns other than competition among individuals or corporate groups to establish political hierarchies. Further to the west, beyond the Apuseni Mountains and into the Carpathian Basin,

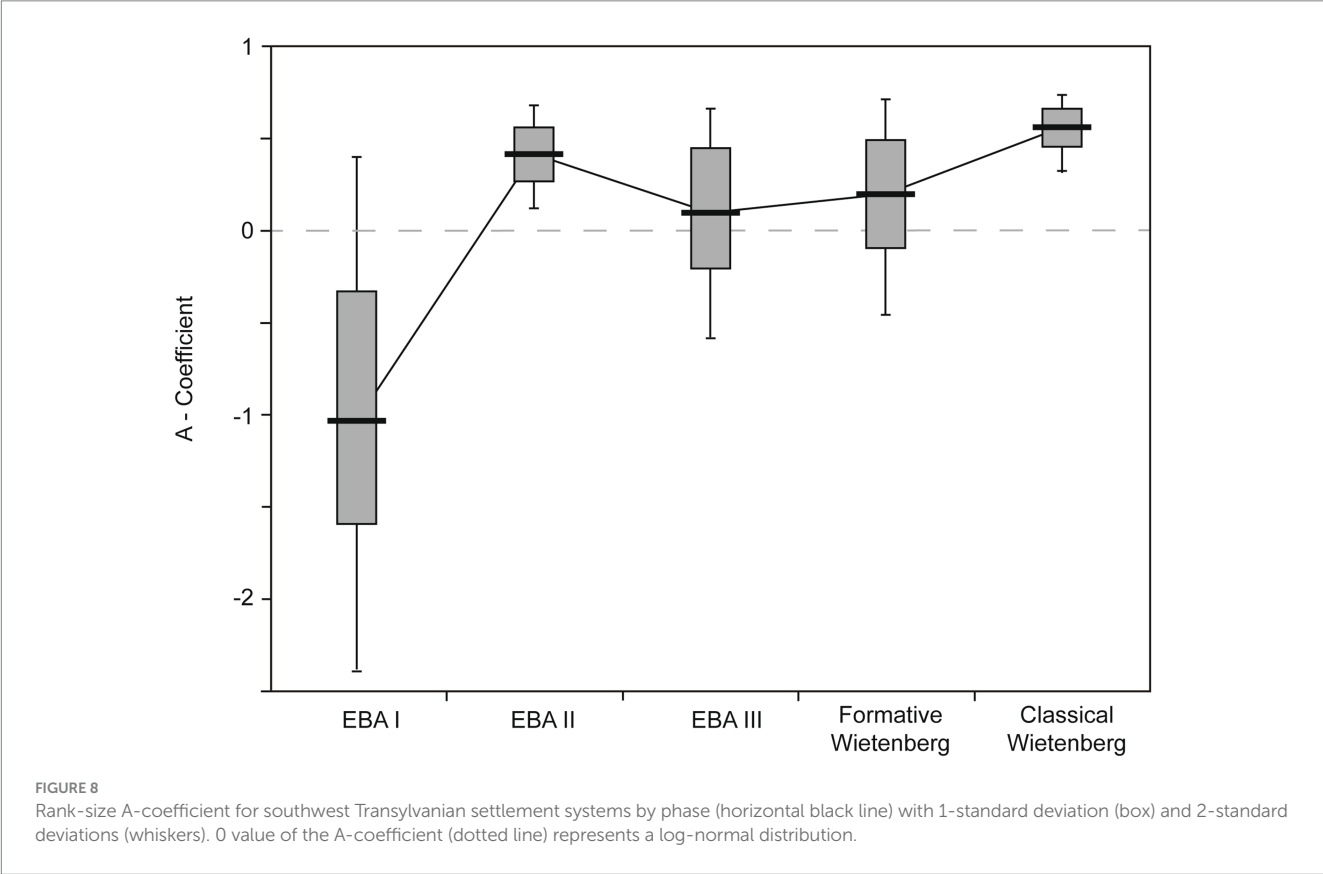
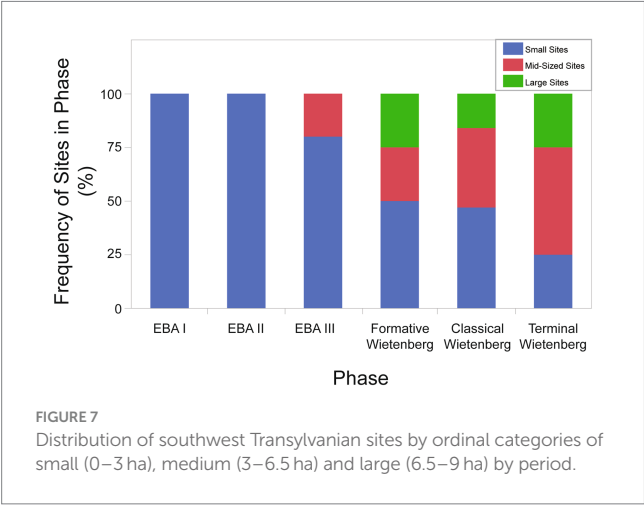
many researchers, including [Duffy \(2014\)](#), [Jaeger et al. \(2018\)](#), [Gogăltan et al. \(2020\)](#), and [Kanne \(2022\)](#), have demonstrated the variability in socioeconomic organization, political centralization, and settlement dynamics between and within different regions of the Carpathian Basin.

The process of settling down in this resource-rich landscape was dynamic. As seen in cases where resources are broadly dispersed (see [Feinman and Neitzel, 2023](#), pp. 6–7), metal ore was difficult to control and there was an increased emphasis on horizontal ties rather than hierarchical relationships throughout the Bronze Age. At the same time, the variability seen in how people positioned themselves in the landscape and relative to each other suggests that the key resources (e.g., from metal to agro-pastoral resources), or key part of the broader

commodity chain (e.g., from extraction to distribution), were likely influenced by changes in historically-specific interactions, fashions, and decision-makers. While the location and abundance of ores did not vary significantly over the 1,500 years of the Bronze Age, where people lived, and the density of their settlements, would have necessitated changes in socioeconomic institutions for the procurement, distribution, and consumption of metal and other key resources over time. The settlement patterns explored in this study provide one view of these dynamics. Economic abundance, rather than the potential environmental marginality of mountain landscapes, may have inhibited the development of more hierarchical societies with significant wealth inequality (see [Leppard, 2019](#)). Future analyses of the temporality, population size, and socioeconomic organization of the emergent towns of the Middle Bronze Age in southwest Transylvania, as done for the much larger Trypillia megasites (see [Chapman et al., 2019](#); [Gaydarska, 2019](#)), may provide insights into the relationship among site size, social inequality, and political authority. Additional work on the organization and distribution of resources in detail at different communities in Bronze Age Transylvania, both large and small, are also needed to better understand the context and consequences of settling down.

Conclusion

This study contributes to a broader understanding of the factors that inform where people chose to settle down and the consequences those decisions have on the development of social, economic, and political institutions. Communities in resource-rich southwest Transylvania balanced agropastoral, crafting, and trade economies



with social institutions to support emergent towns. By the Late Bronze Age, competition over resources played a greater role than sheer abundance in transforming how people positioned themselves relative to each other and the landscape. While people in Transylvania started to live in bigger towns by the Middle Bronze Age, the establishment of regional polities appears to have happened later.

Middle-range societies like those in Bronze Age Europe were dynamic, often driven by the tensions between social, economic, and political institutions (see Quinn and Beck, 2016). Settlement ecological perspectives provide a way to hold these tensions together into a complete view of society. As people balanced their priorities with the risks they entail, these tensions were mediated through the landscape – rendering their decision-making processes visible to archeologists.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

CQ: Conceptualization, Formal analysis, Funding acquisition, Methodology, Visualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The funding for the fieldwork to collect the data used in this study was provided by the National Science Foundation (BCS-1341329), the Wenner-Gren Foundation (grant 8655), the American Philosophical Society.

References

- Bălan, G., Quinn, C. P., and Hodgins, G. (2018). “The cultural and chronological context of the Bronze Age cemetery from Sebeș-Între Răstoace” in *Bronze Age Connectivity in the Carpathian Basin*. eds. R. Németh, B. Rezi and S. Berecki (Târgu Mureș: Bibliotheca Mvsei Marisiensis), 183–216.
- Bandy, M. S. (2004). Fissioning, scalar stress, and social evolution in early village societies. *Am. Anthropol.* 106, 322–333. doi: 10.1525/aa.2004.106.2.322
- Beck, J., Ciugudean, H., and Quinn, C. P. (2020). Bioarchaeology and mountain landscapes in Transylvania's Golden quadrangle. *Bioarchaeol. Internat.* 4, 89–110. doi: 10.5744/bi.2020.2002
- Beck, J., and Quinn, C. P. (2023). Balancing the scales: archaeological approaches to social inequality. *World Archaeol.* 54, 572–583. doi: 10.1080/00438243.2023.2169341
- Birch, J. (2013). *From Prehistoric Villages to Cities: Settlement Aggregation and Community Transformation*. New York: Routledge.
- Blanton, R., and Fargher, L. (2008). *Collective Action in the Formation of Pre-modern States*. New York: Springer.
- Blitz, J.-H. (1999). Mississippian chiefdoms and the fission-fusion process. *Am. Antiq.* 64, 577–592. doi: 10.2307/2694206
- Bondár, M. (2012). *Prehistoric Wagon Models in the Carpathian Basin (3500–1500 BC)*. Budapest: Archaeolingua.
- Borgerhoff Mulder, M., Bowles, S., Hertz, T., Bell, A., Beise, J., Clark, G., et al. (2009). Intergenerational wealth transmission and the dynamics of inequality in small-scale societies. *Science* 326, 682–688. doi: 10.1126/science.1178336
- Boroffka, N. (1994). *Die Wietenber-Kultur. Universitätsforschungen Zur Prähistorischen Archäologie*. Bonn: Habelt.
- Boroffka, N. (2006). Resursele minerale din România și stadiul actual al cercetărilor privind mineritul preistoric. *Apulum* 43, 71–94.
- Brumfiel, E. M. (1992). Breaking and entering the ecosystem: gender, class, and faction steal the show. *Am. Anthropol.* 94, 551–567. doi: 10.1525/aa.1992.94.3.02a00020
- Carballo, D. M., Roscoe, P., and Feinman, G. M. (2014). Cooperation and collective action in the cultural evolution of complex societies. *J. Archaeol. Method Theory* 21, 98–133. doi: 10.1007/s10816-012-9147-2
- Chapman, J., Gaydarska, B., and Nebbia, M. (2019). The origins of Trypillia megasites. *Front. Digital Human.* 6, 1–20. doi: 10.3389/fdigh.2019.00010
- Ciugudean, H. (2012). Ancient gold mining in Transylvania: the Roșia Montana-Bucium area. *Caiete ARA* 3, 101–114.
- Ciugudean, H., and Gogăltan, F. (1998). *The Early and Middle Bronze Age in the Carpathian Basin: Proceedings of the International Symposium in Alba Iulia, 24–28 September 1997*. Alba Iulia: Bibliotheca Musei Apulensis.
- Ciugudean, H., and Quinn, C. P. (2015). “The end of the Wietenberg culture in the light of new ¹⁴C dates and its chronological relation towards the Noua culture” in *Bronze Age Chronology in the Carpathian Basin*. eds. R. Németh, B. Rezi and S. Berecki (Bibliotheca Mvsei Marisiensis: Târgu Mureș), 147–178.

Additional support for this project was provided by the University of Michigan, Hamilton College, and the University at Buffalo.

Acknowledgments

This manuscript owes its existence to the Bronze Age Transylvania Survey Project, an international collaboration between American and Romanian scholars, in particular the research efforts and intellectual contributions by Horia Ciugudean. I would like to thank the Romanian and American archeologists that helped with BATS Project fieldwork, including Anna Antoniou, Mihaela Bleoanca, Dwanna Crain-Sacheleru, Ciprian Daramuș, Elspeth Geiger, Anca Georgescu, Adrian Mariuș, and Ion Sacheleru. The analyses were conducted as part of my dissertation research at the University of Michigan. My research has been significantly enhanced thanks to discussions on the concepts in this manuscript with Jess Beck, Alice Wright, and Lacey Carpenter. I would also like to thank editors Gary Feinman and VT and three reviewers for their insightful comments that have greatly improved this manuscript. All errors and omissions remain my own.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Ciută, B. (2012). *Plant Species within the Diet of Prehistoric Communities from Transylvania*. Cluj-Napoca: Mega Publishing House.
- Crumley, C. L. (1979). Three locational models: an epistemological assessment for anthropology and archaeology. *Adv. Archeol. Method Theory* 2, 141–173.
- Dietrich, L. (2010). Eliten der frühen und mittleren Bronzezeit im südöstlichen Karpatenbecken. *Praehistorische Zeitschrift* 85, 191–206. doi: 10.1515/pz.2010.011
- Dietrich, L. (2014). *Die mittlere und späte Bronzezeit und die ältere Eisenzeit in Südostsiebenbürgen aufgrund der Siedlung von Rotbav*. Bonn: Dr. Rudolf Habelt GmbH.
- Drennan, R. D., and Peterson, C. E. (2004). Comparing archaeological settlement systems with rank-size graphs: a measure of shape and statistical confidence. *J. Archaeol. Sci.* 31, 533–549. doi: 10.1016/j.jas.2003.10.002
- Duffy, P. R. (2014). *Complexity and autonomy in Bronze Age Europe: Assessing cultural developments in eastern Hungary*. (Budapest: Archaeolingua).
- Duffy, P. R. (2015). Site size hierarchy in middle-range societies. *J. Anthropol. Archaeol.* 37, 85–99. doi: 10.1016/j.jaa.2014.12.001
- Earle, T. K., and Kristiansen, K. (2010). *Organizing Bronze Age Societies: The Mediterranean, Central Europe, and Scandinavia Compared*. Cambridge: Cambridge University Press, Cambridge.
- Earle, T. K., Ling, J., Uhnér, C., Stos-Gale, Z., and Melheim, L. (2015). The political economy and metal trade in Bronze Age Europe: understanding regional variability in terms of comparative advantages and articulations. *Eur. J. Archaeol.* 18, 633–657. doi: 10.1179/1461957115Y.0000000008
- Earle, T. K., and Spriggs, M. (2015). Political economy in prehistory: a Marxist approach to Pacific sequences. *Curr. Anthropol.* 56, 515–544. doi: 10.1086/682284
- Feinman, G. M., and Neitzel, J. E. (2023). The social dynamics of settling down. *J. Anthropol. Archaeol.* 69:101468. doi: 10.1016/j.jaa.2022.101468
- Flannery, K. V. (1976). *The Early Mesoamerican Village*. New York: Academic Press.
- Galaty, M. L. (2005). European regional studies: a coming of ages? *J. Archaeol. Res.* 13, 291–336. doi: 10.1007/s10814-005-5110-z
- Găvan, A., and Kienlin, T. L. (2021). “Introduction: Bronze Age settlements in North-Western Romania” in *Bronze Age Tell Settlements in North-Western Romania: Current Approaches and Recent Investigations*. eds. T. L. Kienlin and A. Găvan (Habelt: Bonn), 9–20.
- Gaydarska, B. (2019). “Trypillia Megasites: the first cities in Europe?” in *Coming Together: Comparative Approaches to Population Aggregation and Early Urbanization*. ed. A. Gyucha (Albany: State University of New York Press), 165–187.
- Gilman, A. (1981). The development of social stratification in Bronze Age Europe. *Curr. Anthropol.* 22, 1–23. doi: 10.1086/202600
- Gogăltan, F., and Sava, V. (2010). *Sântana-Cetatea Veche: O Fortificație De Pământ a Epocii Bronzului La Mureșul De Jos*. Arad: Complexul Muzeal Arad.
- Gogăltan, F., Sava, V., and Krause, R. (2019). Sântana-Cetatea Veche. A Late Bronze Age mega-fort in the lower Mureș Basin in southwestern Romania, in *Materialisierung von Konflikten* eds. S. Hansen and R. Krause (Bonn: Habelt-Verlag), 191–222.
- Gogăltan, F., Găvan, A., Lie, M. A., Fazecaș, G., Cordoș, C., and Kienlin, T. L. (2020). “Exploring the Bronze Age tells and tell-like settlements from the eastern Carpathian Basin: results of a research project”, in *Current Approaches to Tells in the Prehistoric Old World*. eds. A. Blanco-González and T. L. Kienlin (Oxford: Oxbow Books), 73–95.
- Gyucha, A., and Parkinson, W. A. (2022). *First Kings of Europe: From Farmers to Rulers in Prehistoric Southeastern Europe*. Los Angeles: Cotsen Institute of Archaeology Press.
- Hanks, B., and Linduff, K. M. (2009). *Social Complexity in Prehistoric Eurasia: Monuments, Metals, and Mobility*. Cambridge: Cambridge University Press.
- Harding, A., and Kavruk, V. (2013). “Transylvania” in *Explorations in Salt Archaeology in the Carpathian Zone*. eds. A. Harding and V. Kavruk (Archaeolingua: Budapest), 41–153.
- Holland-Lulewicz, J., Conger, M., Birch, J., Kowalewski, S., and Jones, T. (2020). An institutional approach for archaeology. *J. Anthropol. Archaeol.* 58:101163. doi: 10.1016/j.jaa.2020.101163
- Jaeger, M., Kulcsár, G., Taylor, N., and Staniuk, R. (2018). *Kakucs-Turján: A Middle Bronze Age Multi-Layered Fortified Settlement in Central Hungary*. Bonn: Dr. Rudolf Habelt GmbH.
- Jazwa, C. S., and Jazwa, K. A. (2017). Settlement ecology in Bronze Age Messenia. *J. Anthropol. Archaeol.* 45, 157–169. doi: 10.1016/j.jaa.2016.12.003
- Jones, E. E. (2010). An analysis of factors influencing sixteenth and seventeenth century Haudenosaunee (Iroquois) settlement locations. *J. Anthropol. Archaeol.* 29, 1–14. doi: 10.1016/j.jaa.2009.09.002
- Jones, E. E. (2017). Significance and context in GIS-based spatial archaeology: a case study from southeastern North America. *J. Archaeol. Sci.* 84, 54–62. doi: 10.1016/j.jas.2017.05.009
- Jones, E. E., and Ellis, P. (2016). Multiscalar settlement ecology study of Piedmont Village tradition communities, A.D. 1000–1600. *Southeast. Archaeol.* 35, 85–114. doi: 10.1179/2168472315Y.0000000007
- Kanne, K. (2022). Riding, ruling, and resistance: equestrianism and political authority in the Hungarian Bronze age. *Curr. Anthropol.* 63, 289–329. doi: 10.1086/720271
- Kellett, L. C., and Jones, E. E. (2017). *Settlement Ecology of the Ancient Americas*. New York: Routledge.
- Kienlin, T. L. (2018). “Borsod region Bronze Age settlement: ‘diversity in uniformity’” in *Borsod Region Bronze Age Settlement (BORBAS)*. eds. T. L. Kienlin, K. Fischl and T. Pusztai (Dr. Rudolf Habelt GmbH: Bonn), 11–92.
- Kienlin, T. L., Fischl, K. P., and Marta, L. (2017). Exploring divergent trajectories in Bronze Age landscapes: tell settlement in the Hungarian Borsod plain and the Romanian Ier Valley. *Ziridava* 31, 93–128.
- Kristiansen, K., and Larsson, T. B. (2005). *The Rise of Bronze Age Society: Travels, Transmissions and Transformations*. Cambridge: Cambridge University Press.
- Laabs, J. (2023). Wealth consumption, sociopolitical organization, and change: a perspective from burial analysis on the Middle Bronze Age in the Carpathian Basin. *Open Archaeol.* 9:20220281. doi: 10.1515/opar-2022-0281
- Leppard, T. P. (2019). Social complexity and social inequality in the prehistoric Mediterranean. *Curr. Anthropol.* 60, 283–308. doi: 10.1086/703174
- Lie, M. A., Găvan, A., Cordoș, C., Kienlin, T. L., Fazecaș, G., and Gogăltan, F. (2019). “The Bronze Age tell settlement at Toboliu (Bihor County, Romania): a brief outline of recent investigations” in *Beyond Divides: the Otomani-Füzesabony Phenomenon*. eds. K. P. Fischl and T. L. Kienlin (Dr. Rudolf Habelt GmbH: Bonn), 351–368.
- Ling, J., Chacon, R., and Kristiansen, K. (2022). *Trade Before Civilization: New Perspectives on Long-Distance Exchange and Social Complexity*. Cambridge: Cambridge University Press.
- Ling, J., Hjörthner-Holder, E., Grandin, L., Billström, K., and Persson, P.-O. (2013). Moving metals II: provenancing Scandinavian Bronze Age artefacts by lead isotopes and trace elements. *J. Archaeol. Sci.* 40, 291–304. doi: 10.1016/j.jas.2012.05.040
- Ling, J., Stos-Gale, Z., Grandin, L., Billström, K., and Hjörthner-Holder, E. (2014). Moving metals II: provenancing Scandinavian Bronze Age artefacts by lead isotope and elemental analyses. *J. Archaeol. Sci.* 41, 106–132. doi: 10.1016/j.jas.2013.07.018
- McClure, S. B., Barton, C. M., and Jochim, M. A. (2009). Human behavioral ecology and climate change during the transition to agriculture in Valencia, eastern Spain. *J. Anthropol. Res.* 65, 253–269. doi: 10.3998/jar.0521004.0065.206
- Némethi, J., and Molnár, Z. (2002). *A Tell Telepek Elterjedése a Nagykárolyi-Síkságon És Az Ér Völgyében*. Cluj-Napoca: Editura Scientia.
- Némethi, J., and Molnár, Z. (2012). *Bronzkori Hatalmi Központok Északnyugat-Erdélyben: A Nagykároly-Bobáld-Tell/Bronzezeitliche Machtzentren in Nordwest-Siebenbürgen: Der Tell Von Carei-Bobáld*. Szeged: Szegedi Tudományegyetem, Régészeti Tanszék.
- Nicodemus, A. (2014). *Bronze age economies of the Carpathian Basin: trade, craft production, and agro-pastoral intensification*. Ph.D. Dissertation, University of Michigan, Ann Arbor.
- Nicodemus, A. (2018). “Food, status, and power: animal production and consumption practices during the Carpathian Basin bronze age” in *Social Dimensions of Food in the Prehistory of the Eastern Balkans and Neighbouring Areas*. eds. M. Ivanova, P. Stockhammer, B. Athanassov, V. Petrova and D. Takorova (Oxford: Oxbow Books), 248–262.
- O’Shea, J. M. (2011). A river runs through it: landscape and the evolution of Bronze Age networks in the Carpathian Basin. *J. World Prehist.* 24, 161–174. doi: 10.1007/s10963-011-9046-6
- O’Shea, J. M., and Nicodemus, A. (2019). “‘... The nearest run thing...’: The genesis and collapse of a Bronze Age polity in the Maros Valley of southeastern Europe” in *Coming Together: Comparative Approaches to Population Aggregation and Early Urbanization*. ed. A. Gyucha (Albany: State University of New York Press), 61–80.
- Parkinson, W. A. (2002). “Integration, interaction, and tribal ‘cycling’: the transition to the Copper Age on the Great Hungarian Plain” in *The Archaeology of Tribal Societies*. ed. W. A. Parkinson (Ann Arbor: International Monographs in Prehistory), 391–438.
- Peterson, C. E., and Drennan, R. D. (2011). “Patterned variation in regional trajectories of community growth” in *The Comparative Archaeology of Complex Societies*. ed. M. E. Smith (Cambridge: Cambridge University Press), 88–137.
- Puskás, J. (2018). “Middle Bronze Age settlement patterns and metal discoveries in the valley of the Black River” in *Bronze Age Connectivity in the Carpathian Basin*. eds. B. Rezi and R. E. Németh (Editura MEGA: Târgu Mureș), 217–278.
- Puskás, J., Stáncsuj, S.-J., Darvas, L., Buzea, D., and Kosza-Bereczki, J. (2023). Chronology of the Bronze Age in Southeast Transylvania. *Dissert. Archaeol.* 3, 77–178. doi: 10.17204/dissarch.2023.77
- Quinn, C. P., and Barrier, C. R. (2018). “Early regional centers: evolution and organization” in *Encyclopedia of Global Archaeology*. ed. C. Smith. 2nd ed (New York: Springer), 1–13.
- Quinn, C. P., and Beck, J. (2016). Essential tensions: a framework for exploring inequality through mortuary archaeology and bioarchaeology. *Open Archaeol.* 2, 18–41. doi: 10.1515/opar-2016-0002
- Quinn, C. P., and Ciugudean, H. (2018). Settlement placement and socio-economic priorities: dynamic landscapes in Bronze Age Transylvania. *J. Archaeol. Sci. Rep.* 19, 936–948. doi: 10.1016/j.jasrep.2017.05.046

- Quinn, C. P., Ciugudean, H., Bălan, G., and Hodgins, G. (2020a). Rethinking time, culture, and socioeconomic organisation in Bronze Age Transylvania. *Antiquity* 94, 44–61. doi: 10.15184/aqy.2019.231
- Quinn, C. P., Ciugudean, H., and Beck, J. (2020b). The politics of placing the dead in Bronze Age Transylvania. *J. Archaeol. Sci. Rep.* 34:102574. doi: 10.1016/j.jasrep.2020.102574
- Quinn, C. P., Walker, E., and Wright, A. (2022). Late Woodland settlement ecology of the Appalachian summit. *Southeast. Archaeol.* 41, 32–52. doi: 10.1080/0734578X.2022.2029803
- Radivojević, M., Roberts, B. W., Pernicka, E., Stos-Gale, Z., Martínón-Torres, M., Rehren, T., et al. (2019). The provenance, use, and circulation of metals in the European Bronze Age: the state of debate. *J. Archaeol. Res.* 27, 131–185. doi: 10.1007/s10814-018-9123-9
- Sherratt, A. (1983). The secondary exploitation of animals in the Old World. *World Archaeol.* 15, 90–104. doi: 10.1080/00438243.1983.9979887
- Smith, E. A., and Coddling, B. F. (2021). Ecological variation and institutionalized inequality in hunter-gatherer societies. *Proc. Natl. Acad. Sci.* 118:e2016134118. doi: 10.1073/pnas.2016134118
- Stone, G. D. (1996). *Settlement ecology: the social and spatial organization of Kofyar agriculture*. Tucson: University of Arizona Press.
- Szentmiklosi, A., Heeb, B. S., Heeb, J., Harding, A., Krause, R., and Becker, H. (2011). Cornești-Iarcuri — a Bronze Age town in the Romanian Banat? *Antiquity* 95, 819–838. doi: 10.1017/S0003598X00068332
- Van de Noort, R. (2004). An ancient seascape: the social context of seafaring in the Early Bronze Age. *World Archaeol.* 35, 404–415. doi: 10.1080/0043824042000185793
- Weitzel, E. M., and Coddling, B. F. (2022). The ideal distribution model and archaeological settlement patterning. *Environ. Archaeol.* 27, 349–356. doi: 10.1080/14614103.2020.1803015
- Zipf, G. K. (1949). *Human behavior and the principle of least effort*. Cambridge: Harvard University Press.



OPEN ACCESS

EDITED BY

Victor D. Thompson,
University of Georgia, United States

REVIEWED BY

Kata Furholt,
University of Kiel, Germany
Ted L. Gragson,
University of Georgia, United States

*CORRESPONDENCE

Katherine Kanne
✉ kate.kanne@ucd.ie

RECEIVED 20 February 2024

ACCEPTED 30 May 2024

PUBLISHED 02 July 2024

CITATION

Kanne K, Haughton M and Lash R (2024)
Common animals: sedentary pastoralism and
the emergence of the commons as an
institution.
Front. Hum. Dyn. 6:1389009.
doi: 10.3389/fhumd.2024.1389009

COPYRIGHT

© 2024 Kanne, Haughton and Lash. This is an
open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](#). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or reproduction
is permitted which does not comply with
these terms.

Common animals: sedentary pastoralism and the emergence of the commons as an institution

Katherine Kanne^{1*}, Mark Haughton² and Ryan Lash³

¹School of Archaeology, University College Dublin, Dublin, Ireland, ²Department of Archeology and Heritage Studies, Aarhus University, Aarhus, Denmark, ³Clingen Family Center for the Study of Modern Ireland, University of Notre Dame, Dublin, Ireland

Animal husbandry was of fundamental consequence in the planning and development of larger and more permanent communities. Pastoralism is often assumed to be highly mobile when considering social institutions and political formations, despite the diversity of husbandry practices that are either wholly, or largely, tethered to relatively sedentary social aggregations. Key tenets of more settled animal husbandry are intensive social relations between people, and between people, animals, and landscapes. This entails reciprocal, multispecies cooperative efforts to decide how to utilize pastoral resources, choose where to settle, and how to organize settlements with an eye for the animals. Yet, scholars have rarely considered how the logistics and social dynamics of pastoralism shaped the transition to sedentism and, particularly, the development of collective forms of governance in prehistory. In this paper, we re-center pastoralism in narratives of settling down, in order to recognize the critical ways that relations with animals shaped how humans learned to move and dwell in emergent grazing landscapes. We take an institutional approach to the concept of “the commons,” demonstrating the dynamics through 19th-century Irish *rundale*, then draw on case studies from Southern Scandinavia and the Carpathian Basin to consider the commons as a multispecies institution which resulted in variable sociopolitical formations of the European Bronze Age.

KEYWORDS

sedentarization, human/animal relations, the commons, Bronze Age, pastoralism, institutions, collective action

Introduction

“The archaeological record is fundamentally a record of cooperative human, and indeed nonhuman, endeavors” (Black Trowel Collective et al., 2024, p. 6).

We settled down with animals. People and animals, alongside plants and other vital entities, cooperated in choreographies of mutual niche-creation manifesting in emplaced multispecies cohabitations. The earliest fortified settlement of Amnya in Siberia (c. 6000 cal BC), emerged from predictable, mass-harvesting of migratory elk and reindeer, and locally rich aqua- and avifauna, enabling large, permanent habitations (Piezonka et al., 2023). Defensible surpluses requiring protection may have fostered extra-group conflict and territoriality, but encouraged intra-group collectivity through monumental construction. Intensively partitioned pasturing of livestock at the Trypillia mega-settlement of Maidanetske (3960–3650 cal BC) in Ukraine needed intra-community cooperation to manage effectively, potentially fostering social cohesion and more collective governance (Makarewicz et al., 2022).

In the European Bronze Age, emergent grazing landscapes developed as open heathlands in Denmark (Haughton and Løvschal, 2023), as divided field systems in southern Britain and Northern France (Fleming, 1998; Evans et al., 2016; Oosthuizen, 2016a; Marcigny and Peake, 2021; Randall, 2021), and as communal pastures accessed from byre houses shared by people and animals in the Netherlands (Arnoldussen and Fokkens, 2008). Presently, half of all habitable land belongs to agriculture, with nearly 80% of it used for livestock (Ritchie et al., 2019). Animal husbandry is the single greatest cause of deforestation (Parlasca and Qaim, 2022), a trajectory with prehistoric roots. The massive land clearance undertaken for agropastoralism reached a global scale by the 1st millennium BC (Boivin et al., 2016; Stephens et al., 2019).

These examples illustrate the difference that animals made to how sedentarization unfolded. More permanent settlements were co-constructed with animals. Forms of social and spatial organization developed which accounted for and responded to their presence, resulting in conjointly inhabited landscapes. Competing interests and mutual affordances had to be recognized and mediated. While agriculture is not a prerequisite for sedentism, domestication processes had particular effects on the socioeconomics of settling down. No longer limited by seasonal and environmentally specific animal abundance, possibilities of residential permanency were reconceived within the biosocial parameters of livestock. Manuring made marginal landscapes into productive arable land, habitable year-round. Harvested fields became winter grazing, supporting greater population densities of people and animals. Livestock surpluses could be monopolized by aspiring leaders (Arbuckle, 2012, 2014a,b; Price and Makarewicz, 2024), though this was not necessarily the case in prehistory pursuant to the institutional dynamics of common-pool pasturage, or “the commons” (Ostrom, 1990).

The commons are foundational to collective action theory in archeology (e.g., Blanton and Fargher, 2016, p. 40; Carballo and Feinman, 2023, p. 6), but how animals participated in this institution remains untheorized. The eternal commons are envisioned as community managed pasturelands for livestock, typically associated with historic, sedentary societies. Commons are materialized expressions of multidirectional relations between animals, people, plants, landscapes, environments, and material culture. They necessitate regular negotiation and cooperation on how to sustainably work these common pool resources. For sedentism to occur in societies heavily reliant on livestock, practical household and community decisions were made about how to rear animals to ensure settled life. Consequently, the commons were present in prehistory (Oosthuizen, 2013, 2016a,b; Haughton and Løvschal, 2023), and remain an enduring institution that persists today. While commons have long been considered a collective action solution to “cooperation problems” among humans, they can also be viewed as emerging from “cooperator problems” between humans and animals in co-evolutionary domestication processes.

In this paper, we take an institutional approach to the commons that emerged in processes of domestication and sedentarization. Institutions are “organizations of people that carry out objectives using regularized practices and norms, labor, and resources” (Holland-Lulewicz et al., 2020, p. 1). Should institutions include nonhumans? We think so, and extend participation in the commons to the domesticated animals on which it relies, for, and with whom, they were created. Our analysis is grounded in a simple premise about the

logistics of animal husbandry: interactions with livestock constitute regularized, routinized, embodied practices and norms that require coordinated labor so that both people and animals can survive through mutual dependence. Generally speaking, the labors of animal husbandry include many tasks that are easier, safer, more efficient, and more effective when undertaken through the cooperation of animals, people, groups and the environment.

We center the analysis of sedentism in the taskscape (*sensu* Ingold, 1993; Hammer, 2014) of animal husbandry, that is, the cycles of daily and seasonal work that sustains the entwined livelihoods of humans and animals. The logistics of keeping domesticated animals alive in the landscape must have played a significant role in configuring social relations and political organization during the emergence of sedentism. By extension, animals can make the difference as participants in collective action, which may have ramifications for the kinds of governance possible. Interspecies collaborations, and their resultant intra-community arrangements, formed the basic building blocks of self-governance, ones which were, and are, often “keystone institutions” of human societies (*sensu* Holland-Lulewicz et al., 2022).

In this paper, we present the recently shifting views of human/animal relations and domestication processes, and then describe how the commons developed as an institution from these processes in the social dynamics of settling down with animals. We illustrate how this institution informs and articulates with various forms of governance, using Irish *rundale* of the 19th century to introduce the dynamics of the commons, then the Bronze Age cases from Europe to examine how this institution instantiated new forms of spatially embedded social relationships between people and animals that were ultimately materialized as the commons as sedentism expanded, and explore how this related to political institutions (Figure 1).

Rather than chronicling the roles animals played in human settling down, we are concerned here with the critical difference that animals made. How was the story of sedentarization changed by the needs, concerns, and actions of animals? This approach reveals how animals shape human lifeways, and forms of settlement and social organization, without falling into a trap of focusing on the agency or intentions of animals in human/animal relations. We are concerned here with how things unfolded, rather than foregrounding particular types of relations. We do not wish to romanticize human-animal relations of the past, but to open our analyses through thinking differently about laboring together. The human domination of animals is an important part of the narrative. In foregrounding the difference that animals made, we do not intend to suggest that human/animal relationships were always (or indeed ever) equal, supportive, or necessarily caring. The affordances for violence provided by proximity to and domination of animals by humans is an equally important part of the history of settling down.

Poco and other theoretical animals

In his masterwork on human cooperation, Blanton (2016, p. 61) describes an example of interspecies sociality:

My cat Poco, from his experience, is quite good at gauging whether or not I'll respond positively to his begging to be taken out for a walk, to be fed, or to be played with, depending on what I'm doing and what time of day it is (although he sometimes



FIGURE 1
Locations of case study sites.

violates his own social algorithm when he wakes me at 5:00 a.m. instead of the allowable 6:00). Poco also uses specific ritualized movements and sounds to communicate his intentions—to be fed, brushed, played with, and so on—and to which he knows I will normally respond, a simple and direct form of social intelligence.

Though used here to consider how cooperation is wired in primate sociality, Poco and Rich effectively demonstrate with this relatable example what most pet owners know: that domesticated animals have a repertoire of routinized movements, sounds, and gestures that elicit reactions and compel humans to respond with relatively predictable behaviors.

These mundane interspecies social interactions are possible because of domestication processes, where individuals of different species make the other aware of their needs and intentions, a sociality crucially important to the organization and management of grazing herds. Companion animals have gotten much attention lately for their cognition and communication skills with humans, but this has only begun to influence domestication theory and archeology (c.f. [Bogaard et al., 2021](#); [Zeder and Lemoine, 2023](#)). Farm animal cognition was not taken seriously until even more recently ([Grimm, 2023](#)), with far fewer scholars employing new ideas about the rich, complex sociality of large domesticates (but see [Brusgaard et al., 2019](#); [Randall, 2021](#)). Livestock are acutely attuned to human emotional states, faces, voices, and gestures (reviews in [Le Neindre et al., 2017](#); [Nawroth et al., 2019](#)).

Discriminating and recognizing individual people, perceiving human emotions, interpreting humans' attentional state and goals, referential communication (perceiving human signals and signals between humans), and social learning have been well established in livestock species ([Jardat and Lansade, 2022](#)). [Beaujouan et al. \(2021, p. 1\)](#), find that,

...the human–animal relationship is a process built through communication and regular interactions between two “partners” who know each other. The goal is to understand how each partner perceives the other according to their multimodal sensory world and their cognitive and emotional capacities, and to predict the outcome of future interactions.

Research of human/animal relations in archeology has undergone radical reconceptualization with posthumanist, multispecies archeologies, dissolving Cartesian binaries, de-centering the human, and considering relational ontologies inclusive of nonhumans as critical to our interpretations of the past (reviews in [Boyd, 2017](#); [Birch, 2018](#); [Cucchi and Arbuckle, 2021](#); [Fuller et al., 2022](#)). Jettisoning a domestication as domination model ([Bogaard et al., 2021, p. 59–61](#)), animals have been successfully recast as co-participants in past societies. Domestication relationships are mostly viewed as cooperative and reciprocally reinforcing ([Shipman, 2010](#); [Mlekuž, 2013](#); [Allentuck, 2015](#); [Zeder, 2015](#); [Anderson et al., 2017](#); [Halperin,](#)

2017, p. 286; Losey et al., 2018; Stépanoff and Vigne, 2018; White and Fijn, 2020; Bogaard et al., 2021, p. 10). They are negotiations between people and animals (alongside plants, landscapes, and material culture) about the terms of mutual, if not necessarily symmetrical, benefits. The causality has moved toward seeing reciprocity in co-constructing niches (Zeder, 2016, p. 333). Relational approaches find agency moving from everywhere in such treaties, “undermining human exceptionalism as the principal driving force in the construction of our world” (Halperin, 2017, p. 286).

Sedentism and domestication processes were entwined in mutual niche construction binding people and livestock together. Early Holocene (c. 11700 BP) people and wild boar at Hallan Çemi in southeastern Turkey shared permanent settlements after pigs took up residence in novel anthropogenic environments of the village (Zeder and Lemoine, 2023). Hunted wild goats became early managed goats in permanent villages of the Zagros Mountains of western Iran (c. 8200 calBC; Daly et al., 2021). Penned, they left hoofprints on mudbricks nearly a millennium before skeletal markers of domestication were identified, while demographic profiles and aDNA indicate regular mating with goats from nearby villages. New methods in soil micromorphological analyses, and livestock fecal indicators, reveal complex social and spatial arrangements that occurred during the settlement of cows and people at Neolithic Çatalhöyük, where increased proximity and management preceded a major settlement expansion (Portillo et al., 2019). Early, intensive horse domestication processes, including directed breeding, milking, riding, and management at Botai, Kazakhstan (c. 3500 BC), enabled people to live year-round in permanent villages without agriculture (Outram et al., 2009; Outram, 2023).

Domestication can be readily understood through an institutional approach. In domestication processes, people and animals solve cooperator problems to carry out objectives using regularized practices with norms governing labor and resources. There are rules of good behavior (e.g., respectful communication, timely provision of adequate food), contingent cooperators (e.g., cows letting down milk only for preferred milkers), and punishment of “free riders” (e.g., culling fractious animals). Furthermore, considering domestication as an institution, as well as a process, situates it within other social and political formations.

Animals should have moved beyond existing as passive resources for human exploitation in archeological theory. However, this view has not consistently been taken up, and less successfully employed to understand how and why human societies change and vary, largely because operationalizing such theory beyond single cases is difficult (but see Brusgaard et al., 2019; Kanne, 2022). Though research in archeology on sedentism, collective action, and governance have developed sophisticated theory that absorbs much of the critiques of the past several decades (Angelbeck and Grier, 2012; Blanton and Fargher, 2016; Feinman and Carballo, 2018; Green, 2021, 2022; Holland-Lulewicz, 2021; Blanton et al., 2022; Nicholas and Feinman, 2022; Carballo and Feinman, 2023; Green et al., 2024), animals remain mute in most archeological theory. Excising western ontologies of dominance is critical in analyses of the past (Black Trowel Collective et al., 2024). As archeological theory has been making space for non-western ontologies in evaluating institutional formations (Blanton and Fargher, 2016; Kowalewski and Birch, 2020; Kowalewski and Heredia Espinoza, 2020; Holland-Lulewicz et al., 2022), we bring animals into the theoretical fold when we consider the socioeconomics

of settling down, and the character of institutions and sociopolitical formations that develop from sedentarization.

The “third science revolution” (Kristiansen, 2014) has positively impacted the ways in which we can understand the past lives of domesticates and human/animal relationships through increasingly high-resolution, multiproxy analyses, including genetics (reviews in Frantz et al., 2020; Scarsbrook et al., 2024), dietary and mobility stable isotopes (review in Kinaston, 2023), geometric morphometrics (GMM; review in Evin et al., 2022), fecal biomarkers and soil micromorphology (Elliott and Matthews, 2023). However, theoretical hamstrings remain in understanding how pastoralism relates to governance and inequality. The roles of animals in political institutions have generally been couched in subsistence, featuring more recently in political economic models (Arbuckle, 2012, 2014a,b; Nicodemus, 2014; Grossman and Paulette, 2020; Kanne, 2022; Caramanica et al., 2023; Price and Makarewicz, 2024), and discussions of complexity (deFrance, 2009; Frachetti, 2012; Gaastra et al., 2020; Adcock, 2022; Ventresca Miller et al., 2022).

Archeologists examining the intersections between subsistence, sedentism, and political formations have also been limited by comparative studies of the cross-cultural variation that divided subsistence into typological categories (foraging, horticultural, pastoral, and agricultural) in a social evolutionary framework that severed animal husbandry (pastoralism) from crop agriculture (farming). An artifact of typological thinking and coding in the Human Relation Area Files and the Standard Cross-Cultural Sample, food producing economies were either agricultural or pastoral, but not both (Murdock and White, 1969). Consequently, cross-cultural studies finding high inequality among pastoralists (e.g., Borgerhoff Mulder et al., 2009, 2010), utilize relatively recent ethnographic cases from mobile pastoralists in marginal environments, not sedentary or tethered pastoralists, or agropastoralists. Haynie et al. (2021), utilizing variables that account for agropastoralism, find that heritable social class is related to the presence of large domesticates, but not hereditary political succession, intergenerational transmission of wealth, or inequality, while environmental variables in agropastoralism indirectly influenced inequality, at odds with earlier research. Those modeling inequality place animals as critical forms of heritable wealth creating greater income disparities (c.f. Kohler et al., 2017), similarly conflate subsistence with residency. This leaves us with a poor understanding of past societies in resource rich, or well managed landscapes that practiced less-mobile forms of pastoralism, where the unequal stockpiling of herd wealth could be subject to community sanctions or used to consolidate power.

Animal husbandry in archeology

Animal husbandry, or pastoralism, has received growing attention from archeologists in recent decades (Frachetti, 2012; Makarewicz, 2013; Carrer et al., 2015; Honeychurch and Makarewicz, 2016; Arbuckle and Hammer, 2019; Ventresca Miller et al., 2019; Costello, 2020; Given, 2020; Marston et al., 2022; Rouse et al., 2022; Honeychurch et al., 2023; Reinhold et al., 2023), though discussions have focused on more mobile forms of transhumance, historical periods, or particular regions, like the Eurasian Steppe. Transitions from nomadic hunter-gatherer lifestyles to sedentary agriculture are now accepted to be neither unidirectional, sudden nor universal.

Agropastoralism is recognized to have played a significant role in subsistence strategies from prehistory to today (Stevens and Fuller, 2012; Feinman and Neitzel, 2023; Thompson, 2023a). Nevertheless, pastoralism remains under-theorized and under-discussed, particularly in European prehistory. There seems to be an assumption that we know what pastoralism generally looks like, and that it is less complex than, and perhaps even a “failure” of, true agriculture (e.g., Stevens and Fuller, 2012) or that it represents a backwards movement, as epitomized by Iversen’s (2016) neo-evolutionary concept of “de-neolithization.”

Pastoralism does place movement at its center, though Cribb (1991) recognized that this need only relate to herds, a strategy he terms “transhumance.” Human mobility, on the other hand, exists on a scale from sedentary to nomadic. While the division this model makes between human and animal movement may be unhelpful (Costello, 2020, p. 11), the notion of a sliding scale between fully nomadic and fully sedentary is supported by ethnographic evidence. Pastoral groups are strikingly variable and flexible in both mobility patterns and procurement strategies (Chang and Koster, 1986; Marshall and Hildebrand, 2002; Bernbeck, 2008; Frachetti, 2012; Porter, 2012; Honeychurch and Makarewicz, 2016). Recent research increasingly documents sedentary or semi-sedentary pastoralism in areas thought to comprise only nomadic groups (Chang, 2017; Haruda, 2018; Ventresca Miller et al., 2020; Rouse et al., 2022).

While “pastoral mobility” relates to the phenomenon broadly, “transhumance” implies a fixed or semi-permanent base returned to over successive seasons, most often winters (Costello, 2020). “Nomadic pastoralism” implies that no such base was used. Pastoralism can also operate where human communities are fully sedentary, and sedentism can be considered part of the repertoire of mobile pastoralism (Honeychurch and Makarewicz, 2016). Demanding pasture, pastoralism is structured and repetitive (Costello, 2020; Randall, 2021). However, this is often taken to imply a linear out-and-back pattern, as in seasonal shifts between uplands and lowlands (e.g., Aldred, 2020), rather than more stationary commons. In other contexts, routes may be much more variable. The basic interactive networks may endure for millennia, though mobility patterns and level of investment in particular locales are much more flexible (Frachetti, 2012).

There is significant variability, too, in the social configurations of mobility, with flexibility in group composition and access to territory (Cribb, 1991; Salzman, 2002, p. 249). More mobile pastoralism may have herding groups comprised of small numbers of people (specialized or otherwise), a subgroup of a community, or entire household groups (Costello and Svensson, 2018). Ethnographically-known pastoral communities exhibit variation in social organization, both from one another and, on a seasonal basis (Graeber and Wengrow, 2021). Though thought of as simple tribal social arrangements, pastoral communities are capable of social arrangements as complicated as any other economic formulation (Porter, 2012).

Livestock were central in transitions to sedentism, and cooperation to live with them was seemingly inherent to efforts of early urbanization. Sedentary or tethered animal husbandry is one of the most common forms of pastoralism in the past and present. In areas where the soil quality and environment permit, or can be improved with manuring, livestock can graze in nearby pastures year-round, either overnighing there, or returning daily to pens in the

settlement. Animals can also be moved in a more transhumant way, alternating seasonally between pastures with herders guarding the flocks, while maintaining year-round settlements. In such cases, herding is often allocated to certain groups defined by age, sex, or class. Taking into account the ethology and biology of individual animals and the herd, we think more sedentary animal husbandry led many people in prehistory to site settlements with respect to combined needs of animals, people, and the landscape; organize settlements and labor in sensible ways with livestock to manage pasturage resulting in commons; and, through the management of the commons, organize governance of societies around such resources, which may have led to a generally more collective ethos than previously considered.

Cooperative, common, and collective animals

“The idea of consensus can be a useful way for thinking about the relationality of humans and nonhumans in ongoing entanglements of people and landscapes” (Halperin, 2017, p. 286).

Constant intra- and interspecies dialogs are required to settle an area, and in long-term residency. Just as people’s interpersonal relationships have been neglected in narratives of settling down (Feinman and Neitzel, 2023, p. 101,436), so too have relationships with animals. We propose that “the commons” offers an institutional framework to redress this imbalance. Commons thinking offers a flexible model for addressing the shared management of resources which are not owned by any one individual or group. As originally outlined by Ostrom (1990), they are rule-bound institutions governing clearly delimited resources according to “rational actor” logics (see Blanton, 2016, p. 31–44). More recent work has extended the framework to large scale, poorly delimited resources (e.g., Moritz, 2016) and explicitly anti-capitalist configurations (e.g., Caffentzis and Federici, 2014; Chatterton and Pusey, 2020). We argue that the commons can be considered a durable institution (*sensu* Holland-Lulewicz, 2021), wherein participants act together to meet their objectives according to a shared set of rules or expectations governing communication, labor, and resource use. Animals partake socially and physically in the development and maintenance of the commons, making and following rules about its use, while laboring in the commons growing offspring and bodies that produce milk, wool, meat, and traction, thus regulating how their labor is shared, thus governing the extent to which different grazing regimes can be used. As such, animals are participants in the institutions of the commons.

To recognize the role animals play in these institutions, we briefly explore the properties which define institutions: *resources and funding, durability, scale, activities and events, labor and work, formality, participants and membership, overlap with other institutions, organizational structure, naming, knowledge, and objectives and outcomes* (Holland-Lulewicz, 2021, p. 3–7). Livestock require fodder and water, protection from predators, shelter based on terrain and climate, and management practices that observe species-specific biology and behaviors, including individual, age, sex, herd, and life-course dynamics, such as breeding, gestation, birth, lactation, and death (see Randall, 2021, p. 54–56; Fuks et al., 2022, p. 6–15). Archeologists are comfortable with the idea that animals can be *resources and funding*, but people are also *resources* for animals, through the provisioning and protection they demand, along with the

resources of the land and environment that allow both to flourish, where commonly held pastures are built through reciprocal *labor*. Pastoral commons arise from these needs and require additional labor, through initial clearing, routine, and seasonal management *activities*. At times, they have a known *scale* or extent, the boundaries of which can be visible archeologically, or inferred through catchment analysis and stocking rates, and can be *durable* for centuries, even millennia (Oosthuizen, 2016a,b). At other times, commons may be so large that maintaining clear boundaries becomes impossible (Haughton and Løvschal, 2023). Historical commons have *names* for the institution, such as *rundale* or *runrig* (Gardiner et al., 2020).

Human responses to livestock's biosocial needs are evident in the routinized ways people communicate with them, through multi-sensory, embodied language (*sensu* Maran et al., 2016) allowing efficiency and safety in routine animal work, like catching, leading, feeding, watering, herding, penning, milking, shearing, doctoring, riding, driving, and dispatching. This is co-joint *labor*. Animals and people do things and move together, where there are proper ways to communicate respectfully. Ignoring respectful communication incites violence, and increases the odds of injury. The individual and species-specific, culturally, and contextually directed rules of communication and engagement are embodied practices that have to be taught to all participants: *knowledge* every person and every animal must know (Lozey et al., 2021; Sharifian et al., 2023). Such communicative, practical norms of labor are institutionalized. People can be further monitored and evaluated by the quality and well-being of their livestock, a highly visible social signal giving testimony to their character.

Pastoralism, and the commons particularly, demands face-to-face negotiation, involving intense cooperation networks established between people and between animals and people (Fijn, 2011; Gardner, 2016; Honeychurch and Makarewicz, 2016; Burentogtokh, 2017; Thomas et al., 2018). *Knowledge* of proper relationships between people and animals, herd and herder, is embedded and transmitted in social relationships within families and herding groups, along with the wider community (Mlekuž, 2013; Bumochir et al., 2020; Sharifian et al., 2023). Decisions about where to herd, when to put animals on specific tracts of pasture, and which to cull, are informed by the kinds of animals herded, the ultimate resources to be taken from them, and who is available within the labor pool to get all of this done (Zeder and Lemoine, 2023). Beyond this, social relationships requiring animal exchange, animal products or labor, *events* such as weddings and feasting, along with interpersonal human/animal relationships that alter the course of more practical associations, can elicit alternative decisions that supersede more prosaic concerns.

The *organizational structure* is collective for the commons, but families or herding groups may identify different segments or be represented by selected participants with institutional knowledge and skill. Decision making at the household level about who is appropriate to do what with which animals are culturally dependent, but often are by divisions of sex, age, kinship status, class, and ability. Decisions about appropriate husbandry and management strategies, and enforcement of such norms, must work within the parameters set by domesticated livestock: what the makeup of the herd is, which species are present, the numbers of each, their sex and their ages, what they eat, and how much, how much water they require, individual personalities, and so on. Households cooperate to pool *labor*, organizing herding groups to meet livestock needs, requiring

coordination beyond individuals or close kin. Honeychurch (2014, p. 294, 295) describes these organizational tendencies of pastoralists, including a willingness to distribute decision-making, a capacity for higher levels of autonomy in related communities, and a political emphasis on inclusiveness. As a result, pastoralist societies were organized institutionally with some affordances toward collective governance.

Næss (2021) highlights *labor* constraints as the reason that herders cooperate and form herding groups on commonly grazed landscapes, which is especially important in mobile pastoralism on open landscapes, requiring near constant human presence. In mixed herds, different kinds of livestock have different graze and water requirements, varying by season, landscape, predator and theft threats. Mixed and single species herds, dry and milk herds, male and female ones, mother/offspring pairs, and juvenile groups are some possible configurations of managing livestock informed by their biological needs, alongside human requirements of them, often requiring collaboration above the household, changing daily, seasonally, and in the participants' lifetimes. "Pastoralism is thus practised in a web of potential cooperative relationships; relationships that can be actualized and discontinued depending on social context and environment. Cooperative networks thus contract or extend depending on the circumstance" (Næss, 2021, p. 6).

Chazin (2023) helpfully introduced the concept of "animal labor" within herding practices, circumventing human exceptionalism through examples from Late Bronze Age settlements in the South Caucasus (c. 2500–1500 BC). Herds and herders coordinated *labor* together as a "key form of action that created and maintained the culturally and historically specific forms of value that shaped social worlds and political authority" (Chazin, 2023, p.3). Zooarcheological and biogeochemical analyses documented the expansion of a range of carcass and secondary products arising from extending birth seasonality, which compelled significant effort on the part of sheep, and demanded different labor from the people to attain it. This commanded intensive interventions and additional work from both parties, possibly strengthening interspecies social relations, as they would be in close bodily contact during all seasons, which may have, "led to a sense that humans and their flocks were a joint social "unit," formed out of co-mingled genealogies and joint (re)production" Chazin (2023, p. 12).

Material correlates identify, define, and characterize institutions at multiple levels (Holland-Lulewicz, 2021), locating the commons at regional to local scales. Prehistoric settlement patterns may attend to practical animal management on common institutions (Ombashi and Løvschal, 2023), so that they can be accessed equitably, and with respect to neighboring common institutions. Physical management of domestic livestock was important, including the *resources* of penning and handling facilities, as well as the droveways, fields, and pastures. We further suggest this materiality records the commons as *spatially embedded social relationships* inscribed on landscapes through the regular, patterned co-labor of people and animals, resulting in "animal architectures" (Anderson et al., 2017). With a human and an animal eye view, Randall (2021, p. 56–59) terms these animal architectures the infrastructures of the commons, which make the institution possible and identify it materially.

In a series of landmark papers, Oosthuizen (2013, 2016a,b) deftly interrogated the commons through a property rights approach, following Ostrom (1990, p. 90–102), outlining possible material

correlates of the commons that attest to its *durability*, *scale*, *activities*, and *events* (Oosthuizen, 2013, p. 721–725). For prehistoric Britain, this includes earthworks (ditches, hedges), with open areas within them, not subdivided so there is equity in pasture access; small habitation sites in uplands where transhumance was practiced seasonally, such as a stock pen at Lower Hartor Tor in Dartmoor; herds that exceed the size that single farmsteads could have managed, as at Casterly Camp, Wiltshire (Cunliffe, 2004, p. 246); and evidence for seasonal gatherings or feasting in open pasture, where meetings could be held by common rights-holders to discuss management issues that arise, coinciding with seasonal round-ups of livestock on more open ranges. Following these conditions, Oosthuizen (2016a, p. 722) finds that the “governance of at least some British prehistoric arable and pasture may well have been undertaken collectively within CPRR [Common Property Regimes]” without assuming strictly egalitarian political formations are inherent to the commons. Even in prehistory, individual farmsteads with quality agropastoral land at the same time as commons were used, could lead some to accumulate more wealth than others.

The implications following the identification of the commons are similar to other institutions, like the *overlap* with other groups or governing institutions. The *durability* of the commons is due to “the meta-structures underlying conceptions of and practice in relation to the governance of common pool resources” (Oosthuizen, 2016a, p. 726). That is, the commons as an institution have an underlying logic based on human/animal organizational principles leading to its stability and repeatability over time, or a “framework” (Ostrom, 1990). This accounts for the endurance of the commons in a number of places, as well as the landscapes that contain them, like the Danish heathlands and British commons, though they passed through many different types of political and common institutions.

Collective action theory and common animals

“Collective action theory seeks to understand how people overcome cooperation problems associated with the production and use of communal resources” (Thompson, 2023b, p. 509).

Settling down with animals provokes cooperation problems in terms of how to balance the biosocial demands of livestock (fodder, water, protection) with the needs and wants of all the members of the community reliant upon them. The commons as an institution are organized to solve the inherent cooperation problems of sedentary or tethered pastoralism, including the risk of overexploitation of pasture as a resource with high subtractability (Ostrom et al., 1994, p. 4). Critical to this process is that members of commonage groups comply with using the commons sustainably so that it secures the success of the group, agree that such usage will be monitored, and are assured that those who deviate from the rules agreed upon by the group will be sanctioned or excluded from the benefits derived from it (Blanton and Fargher, 2016, p. 40–41; Ostrom et al., 1994, p. 3).

Collective action theory in anthropological archeology highlights that more collectively governed societies have a greater reliance on local production of goods, including agropastoral products, more communally owned and managed land, greater social homogeneity, and a greater expenditure on public goods (Carballo and Feinman, 2023, p. 16; Table 1), including land clearing, ditch construction, and

TABLE 1 Measures of collective action in the commons.

Measures of collective action in the commons	Evaluation criteria
Group size	Population estimates
Social homogeneity	The degree that material culture, such as pottery, house size, mortuary practices, and grave goods are similar or different
Communal labor	Group efforts such as land clearance, ditch or enclosure building, commons maintenance
Boundaries	If the commons are unenclosed, partially enclosed, as in infield-outfield system, or completely open
Livestock > household	If households have more livestock than they could manage
Commons seasonality	If the commons are utilized year-round or only seasonally
Arable agriculture to pastoralism	The ratio of arable agriculture compared to pastoralism for subsistence
Domesticated species abundance	The relative abundance of domesticated species from the fauna or historical records
Species products	How many different kinds of primary and secondary products produced to evaluate how many of types of herds present
Settlement type	Farmstead, hamlet, small village, large village
Land quality/commons management	Land quality to stocking rates; the effort required to maintain graze, and if seasonal or rotational movements are required
Levels of bureaucracy/leadership	How nested the institution of the commons was in governance or if the commons management provided social structure
Extent of the trade of animals or secondary products	Evidence for the exchange or trade of animals or secondary products or if most products consumed locally
Land or Labor Limited	The degree to which land or labor constrain pastoralism
Excludability	How easily non-members may be excluded from the commons
Subtractability	How easily the commons can be overexploited

commons maintenance. The more leaders rely on local labor and production, the greater voice all participants have (Levi, 1988; Blanton and Fargher, 2016). Decisions to cooperate rely on group size, the degree of social heterogeneity, the frequency of face-to-face interactions, the public benefits, the extent to which reputation and reciprocity matter, and the group members’ abilities to monitor and sanction free riders (DeMarrais and Earle, 2017, p. 183–185; Olson, 1965; Ostrom, 1990, p. 90; Ostrom and Walker, 2000, p. 438–439).

That labor is the primary reason herders cooperate (Næss, 2012, 2021), divulges possible solutions to collective action problems. Cooperation decreases overall labor input from each household, increases the possibility of extra-pastoral production, and decreases the risks of animal loss from lack of labor, predation or theft. Cooperation is only effective up to a point as the costs of cooperating in herding lead to greater levels of conflict and increased grazing

pressures. The scale is important. Herding groups tend to be small, and composed of closely related kin, with regular face-to-face communication. Thus, monitoring and punishment of rule-breakers (free-riders) are possible.

Ebersbach (2010, 2013) finds if pasture is an unlimited resource, it belongs in common to the lineages or herding groups using it. There is a tendency for herders reliant on cattle, or other large domesticates like horses, to cooperate more because they require different handling than small stock (Ebersbach, 2010, 2013). Seasonal movements to pastures, and multiple secondary products require additional labor from people and animals, such as dairying, milk processing, wool processing, hay making, and traction, resulting in a number of different “subsystems” of animal management that can only be handled above the household level, including up to the whole village, which can provide a blueprint for community leadership. Following Chazin’s (2023) logic, this requires greater coordination and labor from *animals themselves* to cooperate with people in pastoral rounds. Daily and seasonal routines are multispecies taskscape, increasing the frequency of interactions and the intimacy of relationships with people. These are the spatially embedded social relationships between people, animals, plants, and the environment that produce the commons.

The commons are not just a “shared resource,” but dynamic multispecies landscapes with many participants. Agency of people at multiple scales has been highlighted as intrinsic to collective action (DeMarrais and Earle, 2017, p. 183), but the agency of animals has not. Considering collective action through the institution of the commons in sedentary societies requires recognizing contributing parties at multiple scales, including the animals, who cooperate, labor in, and make it. Their biosocial needs and affordances shape time and space, life, community, and governance. Animals were participants in the commons, and, by extension, may also be in collective action. Reciprocal learning between herders and animals is key to commons success (Molnár, 2017, p. 522). Gosden (2013, p. 112) documents how sheep hold knowledge about particular landscapes that mediates between people and place through the process of “hefting-on.” Here, young ewes become attached to a particular tract of land (heft), by socialization from the older ewes, thereby organizing the work routines of shepherds who herd them, and the landscapes where they reside. Animal knowledge in pastoralism, includes epigenetic transmission, but also animals learning the land and herders, where livestock carry knowledge over generations (Sharifian et al., 2023, p. 7).

Varying kinds of leadership and political institutions may have developed out of collective action problems solved through commonage arrangements and management because of the negotiations required to maintain them. If, as in the commons, animals and land are horizontally distributed, collective action is probable; if animal wealth can be monopolized, inequality, and hierarchical social organization can ensue (Feinman and Neitzel, 2023, p. 6). There is clear historical and archeological evidence where pastoralism and the commons have funded polities, kingdoms, and empires, where the more collective commons are subsumed into hierarchical institutions. For example, in post-Roman Iberia, the commons affected the ways polities and territories were ordered and governed at the local and supra-local scales, social inequality was marked in differential access to the commons, and its control was central to the development of medieval political authority (Carvajal

Castro, 2021, p. 339). In medieval England, commons persisted in shifting sociopolitical contexts (Banham and Faith, 2014, p. 157), and were likely a factor in the territorial organization of kingdoms (Oosthuizen, 2011). Thus, the commons can play a role in local and supra-local sociopolitical organization as a multi-layered institution that articulates within a “constellation of institutions” (Holland-Lulewicz, 2021).

Model of collective action in the commons and its impacts on governance

How can archeologists assess the role of animals, the extent of collective action, and the relevant sociopolitical formations within the commons as institutions? The following variables enable evaluation of collective action in the commons (Table 1). We suggest that communities with small group size, high social homogeneity, regular communal labor for commons management, herds greater than single households could manage, year-round commons grazing, less arable agriculture than pastoralism, more large animals, and more types of secondary products (meaning more classes of animals needed to be kept apart), they will tend to be more collectively governed. The greater number of people working with animals in daily tasks increases cooperative efforts of the animals, and increases their effects on the common’s character and organization. Land limited arrangements would have a greater risk of overexploitation, while labor limited commons would have difficulty in producing a large surplus of pastoral products.

The variability in commonage is based on its scale, quality of land, type of pasture management, the boundedness of the community, and levels of bureaucracy and trade. Those on poor quality land, with bounded farmsteads, with clear leaders, and nested in more bureaucracy, with large group sizes, will be less collectively governed. Here, the commons can be part of a hierarchical system of political organization, yet remain an institution where collective action among commoners persists. When individual farmsteads sharing commons become enclosed, even if land has been distributed equitably to begin with, there is a greater potential for sociopolitical inequality.

Case studies

We explore the commons across three case studies to suggest under which circumstances sedentary agropastoralist societies tend toward more or less collective. These case studies were selected because they have sedentary agropastoralism, and each author has long-term research sited in these regions, providing comparisons of how sedentary pastoralism and the commons were organized in variable landscapes. Following Hammer’s (2014) reading of Ingold (1993), we situate our analyses through the taskscape of sedentary pastoralism of the commons as they unfold in the combined activities of people and animals. Based on the available environmental, zooarcheological, material, and spatial evidence, we envision how animal husbandry would have operated on a daily and seasonal basis, creating the commons and defining its character in order to assess its effects on social organization.

Rundale: imagining the commons

When all the potatoes were dug and pitted (stored in pits) the winter season was in full blast and as there were no proper hedges dividing the different holdings, many of which were in *rundale*, the whole land became a commonage until next Patrick's Day. Cattle and sheep were free to roam over miles of tillage lands without fear of molestation by the owners of the soil, and even to the present day the practice exists but in a gradually decreasing degree as the years roll by. [Michael Corduff of Rossport, county Mayo. National Folklore Collection 1253: 107 (in Yager, 2002, p. 157, 158)].

Rundale refers to a regime of landholding and agropastoralism found in western Ireland in the 19th and 20th century (Aalen et al., 1997, p. 79–82; Yager, 2002; Bell and Watson, 2008, p. 24–27; Slater and Flaherty, 2009; Flaherty, 2015). Developed to sustain crop and animal husbandry within marginal environments through common resource management by a collective of tenant farmers, it bears comparison with collective farming systems from similar historic and environmental contexts, such as Scottish *runrig* and Northern English open-field farming (Gardiner et al., 2020). Our purpose in considering *rundale* here is not to present it as an ancient survival or as an ideal model for prehistoric forms of land management. Instead, we hope to illustrate how the labor demands of agropastoral regimes can influence settlement forms and social relations. In particular, *rundale* demonstrates the potential for commons to be subsumed within more hierarchical forms of sociopolitical organization; the role of animals in both encouraging and straining forms of collective action and commonage maintenance; and the articulation of commonage management with other social categories and institutions, such as kinship, ritual, gender, age, class, ritual, and cosmology. *Rundale* was undoubtedly a multi-species affair, an undertaking structured by the affordances of the potato, the biosocial needs of livestock, and human capacities for collective action within densely populated but ecologically marginal landscapes.

Irish *rundale* developed against the backdrop of colonial inequality and the propagation of the potato as a subsistence crop. With the most fertile land reserved for market agriculture, landless tenant farmers, predominantly Catholic, were forced to make a livelihood in marginal land. Because of its hardiness and nutritional value, potato cultivation, supplemented with animal husbandry, generated unprecedented population growth in formerly the least densely settled areas of the west (Aalen et al., 1997, p. 85, 86; Feehan, 2012). As such, 19th-century *rundale* accompanied substantial intensification of settlement, and sometimes, the expansion of sedentary agriculture into new areas. As Whelan (1994, p. 64) puts it, “Cooperative management, agreed land use and a joint labor system for certain tasks was a sophisticated ecological adjustment to using a fragile environment where technology and capital were limited but labor was unrestricted.”

Flaherty (2015, p. 25, 26) outlines features related to settlement location and morphology, land tenancy, demographics, local governance, and agricultural practice that are, when co-present, diagnostic of *rundale*. Typically, households of tenant farmers lived within a nucleated village (*clachan*), with a nearby infield for arable cultivation and a more remote outfield for common pasture (Figure 2). The infield was undivided and plots worked by individual households

scattered to ensure fair distribution of risk and quality land. Plots were used for rotations of potato and grain crops and periodically redistributed among the collective (perhaps every 1–3 years). After every autumn harvest, the infield reverted to pasture, where every household's livestock could roam freely. Cattle and sheep were most prominent alongside pigs and goats. The taskscape of the infield-outfield system engendered particular kinds of interactions between people and livestock, which varied seasonally, and directly affected how social networks shifted with animal bodies.

The grazing of animals on the stubble of the infield restored the infield to commonage while providing essential fertilizer for the subsequent year. In late spring, livestock were driven to the outfield and kept away from crops during the growing season. In some cases, a particular subsection of the community—especially adolescent women—would undertake seasonal transhumance and live with livestock in upland settlements known as “*booleys*” (Costello, 2020). Traveling with livestock to upland areas was necessary for the daily collection of milk and the production of dairy products, particularly butter.

This cycle of labor was managed collectively under a joint tenancy agreement, in which the village as a whole rented the land from a landlord and provided bulk rent payments. In many cases, a local headman known as *an rí*, “the king,” served as an intermediary with estate agents, adjudicated disputes, and negotiated the redistribution of arable plots and commonage rights, sometimes among a council of elders (Danachair, 1981; Slater and Flaherty, 2009, p. 13, 14; Yager, 2002, p. 158, 159). Regulation of the number of livestock on the commonage was particularly important to prevent overgrazing. Other common pool resources in *rundale* included seaweed (used for fertilizer), woodland, and turf (used for fuel).

Rundale shares features identified by Ostrom (2000, p. 149–153) as design principles of potentially durable self-organizing resource regimes. For example, *rundale* systems had clear “boundary rules” determining which people and animals participated in the regime and who was excluded. In many cases, this was limited to the households living within a village cluster. Local rules constrained resource exploitation according to specific local conditions: when, where, and how many animals could graze the commonage. Participants in the regime had some say in shaping these rules. Through consultation with local councils and “kings,” villagers had the ability to negotiate and adapt these rules to new circumstances, adjudicate disputes, and punish rule-breaking. Not everyone held equal voice: male heads of households and those with larger kin-networks likely held greater sway. Finally, collaboration was nested within multiple social scales, with individuals collaborating within households, households collaborating within kin-networks, and kin-networks collaborating within the overarching *rundale* system. However, *rundale* systems were also subsumed within a hierarchical political economy, in which outside authorities (estate agents and landlords) considered the rule-making rights of tenants and collective landholding to be inimical to improvement and the collection of rent (Knight, 1836, p. 59, 93).

Analyses of *rundale* often highlight its fundamental connection to potato cultivation, but the role of animals as participants in the institution is worth greater consideration. The successful interaction of the arable and pastoral components of *rundale* relied on controlling the timing and location of where animals ate and where they defecated. Grazing animals are liable to trespass at times of scarcity and when insufficiently monitored, potentially upsetting local rules governing seasonal land use. Privately

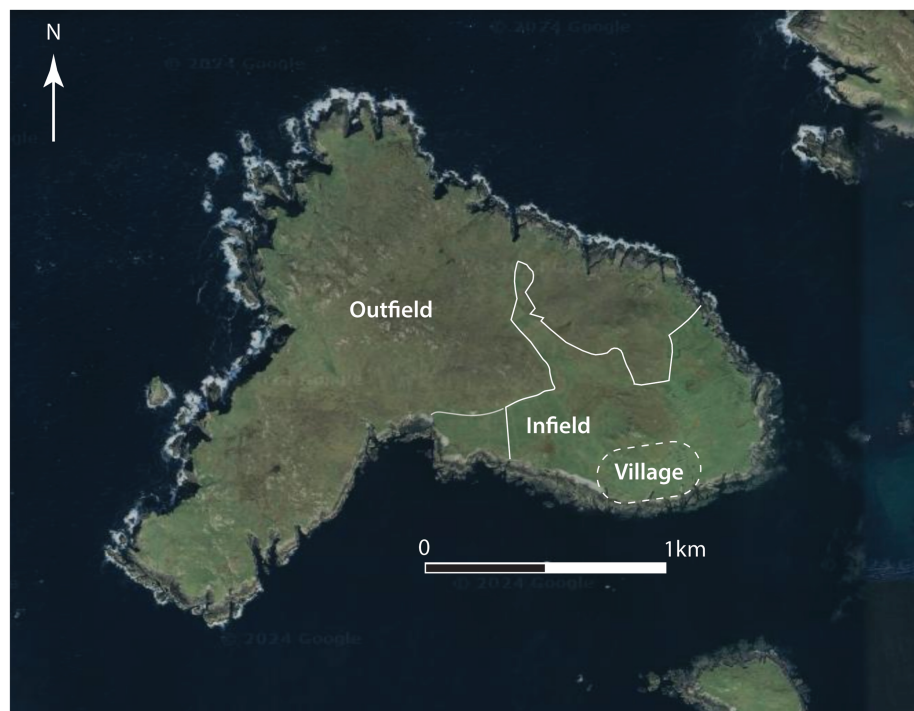


FIGURE 2

Aerial image of Inishark Island, Co. Galway, off the west coast of Ireland. The historic village settlement on the island developed from the mid-18th century and was evacuated in 1960. Documentary records and folklore suggest that this village was under rundale prior to the mid-19th century. An Ordnance Survey Map produced in 1838 shows the settlement organization at the time. The dashed white line shows the approximate extent of the village cluster, which in 1838 consisted of 30 buildings (houses and outbuildings) for around 200 people. The village was surrounded on either side by an undivided infield. This was used for potato and cereal crops, but reverted to common pasture after the harvest. The solid white line shows the boundary wall dividing the infield from the outfield on the 1838 Map. The outfield was used for common pasture throughout the growing season.

owned animals destroying crops in the infield was a recipe for conflict. Such animals might find themselves punished (run off the land or culled) and leave their owners vulnerable to censure or retribution. Summers with poor growth and hard winters could leave livestock with insufficient pasturage in the outfield, requiring supplemental fodder, including in some cases, the provisioning of vital food-stuffs more typically used for human consumption, including potatoes and maize meal (Horne, 1873, p. 52, 53). The feasibility of rundale and the maintenance of human livelihoods were fundamentally entwined with the needs and behaviors of livestock.

Moreover, the logistics and lived-experience of managing livestock shaped the complexion of social relations within rundale. As Costello (2017) demonstrates, *booleying* represented an important forum for social learning in which young people could enjoy a degree of freedom from social surveillance, negotiate social ties, and get to know prospective marriage partners. Based on participant observation among livestock farmers on Inishbofin Island, Ireland, Lash (2019, 2020) argued that farmwork generates a degree of intersubjectivity among humans and animals, that is, a shared embodied knowledge of one another and the possibilities afforded by their encounters. This is characterized by a sensitivity to bodily comportment and a capacity to predict and elicit desired behaviors through gestures, calls, and coordinated action (Figure 3).

The application of embodied knowledge in farmwork can generate cooperation as well as interpersonal conflict. The shared experiences and know-how to manage animals might have buttressed ties of kinship,

locality, class, and age-group affiliation. On the other hand, mismanagement of livestock, disputes over boundary demarcation, commonage rights, and trespass could generate disputes within rundale regimes (Connell, 1950, p. 78). In his study of conflict in County Mayo in the early 19th century, McCabe deems trespass “the archetypal difficulty of rundale” and the major motive for assaults in cases recorded in the petty sessions of local courts (McCabe, 1991, p. 134). Animals were individual household property nevertheless reliant on both cooperative labor and common pool resources. The daily and seasonal work of animal husbandry generated repeated opportunities for both the maintenance and fracturing of collective bonds.

The labor demands of rundale relied on cooperation, but could not simply ensure harmonious collective action. The presence of other social institutions enhanced the feasibility of commons management within rundale regimes. The most obvious of these is kinship, as collectives of tenants were typically composed of closely related households. Yet, ties of kinship could also spur competition and conflict. Shared conventions of ritual and belief in the supernatural also reinforced adherence to collective regimes. Some scholars have suggested that associations between boundaries and otherworldly forces, such as fairies, embedded a moral code in the landscape, threatening supernatural censure for the transgression of conventions of land-use (Catháin and O’Flanagan, 1975, p. 267, 268; Slater and Flaherty, 2009, p. 15, 16). On Inishark Island, Lash (2023, 2024) argue that a rundale regime in the early 19th century was sustained in part by a parallel system of ritual commonage, in which



FIGURE 3

A group completes the gathering of sheep on Inishark Island in 2017. Uninhabited since 1960, the entire island is now used as commonage by farmers from the neighboring island of Inishbofin and the nearby mainland. Gathering sheep free to roam the entire breadth of the island (c. 2.5 km²) requires a great deal of coordination and mutual awareness between gatherers and dogs, often while spaced a great distance from one another.

monuments associated with a local saint cult relied on collective stewardship and could punish mis-use of common resources for individual needs. Rundale developed in adaptation to specific ecological and political economic conditions, but its feasibility relied on articulating agropastoralism with other social institutions that could encourage collective action.

Emergence of the commons: heathland expansion in Northern Europe

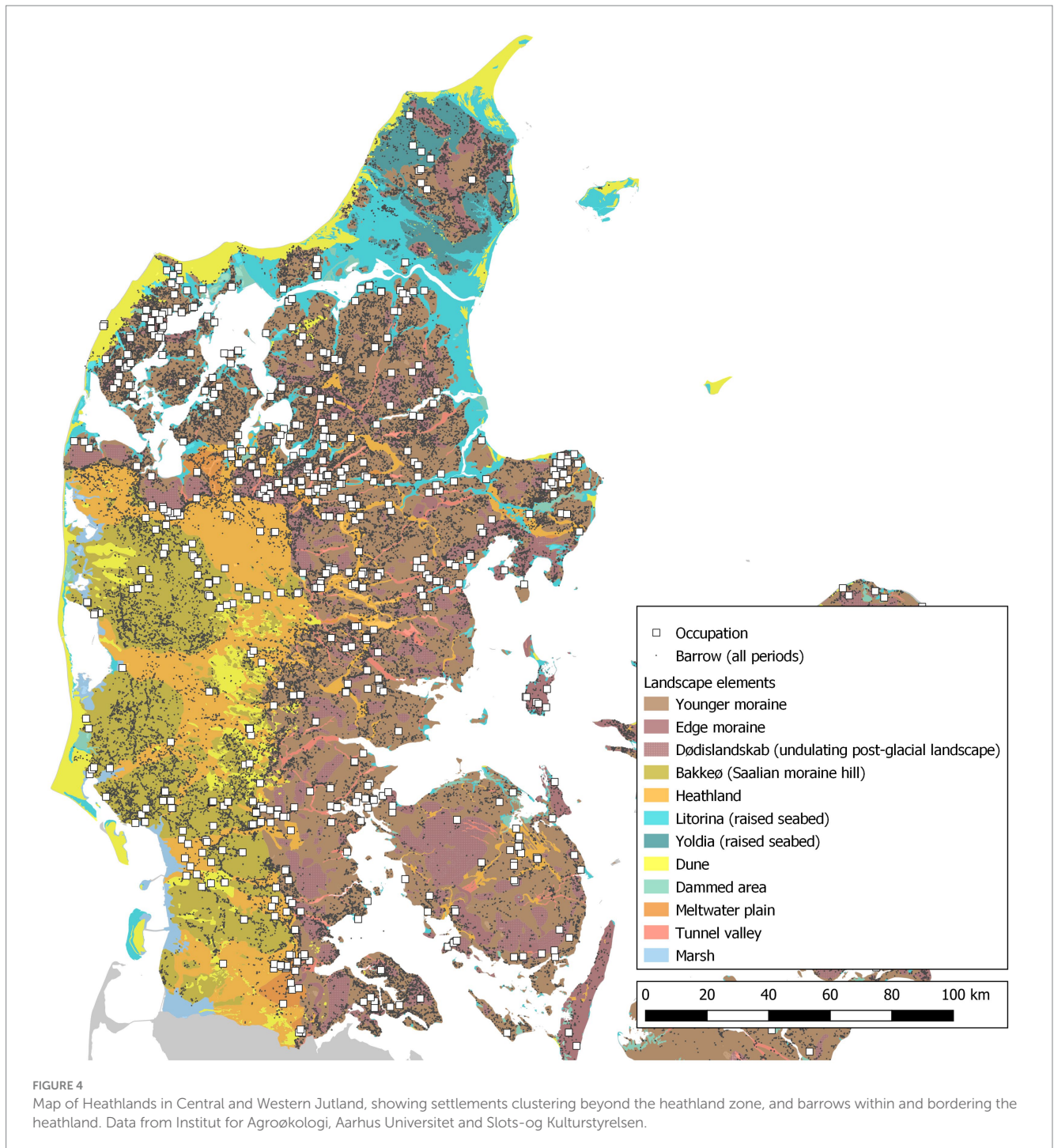
“Settling down” in the Northern European forests involves something of a contradiction. Many of these landscapes were settled in ways which afforded, and indeed required, mobility. Deforestation proceeded irregularly, characterized primarily by emerging landscapes of pasture, and limited areas of crop production. Small meadows within the forest provided grazing for animals prior to clearance (Vera, 2000), likely selected for further clearing as pasture emerged in a piecemeal fashion (Odgaard, 1994; Haughton and Løvschal, 2023). This process occurred across Northern Europe, with growing patches of grass and heath pasture developing through later prehistory (Løvschal and Damgaard, 2022).

A key example of this occurred in Western Denmark, where the sandy soils of Central and Western Jutland supported growing expanses of heathland. Initial populations of livestock were apparently grazed within forests from the fourth millennium BC, with a seeming preponderance of cattle (Johannsen et al., 2016). The third millennium BC brought the first lasting clearances, with patches of heathland appearing Western Jutland’s sandy soils, and some areas oscillating between heathland and forest (Odgaard, 1994). The expansion is associated with new landscape practices—both the regular burning required to keep heather vegetation palatable for animals and to prevent forest succession (Gimingham, 1993), and new practices of burial mound

construction. Corded Ware pottery accompanied the dead under small, low barrows, built in heathland zones, often constructed from heathland turfs, and arranged in linear formations (Andersen, 1998; Hübner, 2004).

This instantiated a system of interconnected communities managing growing tracts of pasture, within a zone of constant ancestral presence. Critically, however, this was a world which compelled movement – both to access and to maintain the pastoral resource. Unlike rundale, which developed under population pressure, Danish Bronze Age settlements clustered away from heathland areas (Haughton and Løvschal, 2024; Figure 4), and mobility of both sheep and, presumably later in the year, cattle, can be inferred. The heavy reliance on animals for food and clothing (Sørensen, 1997; Frei et al., 2017; Skals, 2020) compelled movement of at least some people throughout the Neolithic and Bronze Age. During the initial expansion of heathlands in the Middle Neolithic (2850–2350 BC), the lack of permanent houses suggests this may have been of the entire, or most of the, human community (Haughton and Løvschal, 2023). By the Early Bronze Age (1700–1100 BC), substantial longhouses and associated crop production suggest that a portion of the community were sedentary. Nevertheless, the heathland pasture in western Jutland was maintained, and in fact continued to expand, while further barrows continued to be built in this realm, demonstrating the frequency of return.

In these landscapes, the taskscape of daily life were strongly structured by the needs of animals, plants, and the ancestors (Haughton and Løvschal, 2024). Herds of cattle and sheep pulled the human community in different directions, with some people traveling with animals into the heathland pasture, and animals presumably bringing people together for larger tasks – such as gathering animals off the heath, and the managed burning of the pastoral resource. Households may have operated relatively independently on a daily basis, taking charge of their own small herds within the heathland, or perhaps pooling the resources of several households together for the summer months. Both animals and people must have traveled from home bases



in the early summer, and the distances involved (Figure 4) suggest that many herders would have been separated from the homestead for some time. Given the poor preservation of animal remains and the mobility inherent in the system, assessing herd size is difficult, but two pieces of evidence point toward the relative independence of household communities. Firstly, settlements were generally small, often consisting of single or paired farmsteads. In some areas, such as Thy in the northwest (Bech et al., 2018) or the banks of the Kongeå river in the south (Holst and Rasmussen, 2013), farmstead densities approached 0.5–1 per km², but this was rare and still indicates relative independence. Secondly, the construction methods for heathland barrows suggest small working groups, acting with relative

independence though to a shared overall plan (Holst and Rasmussen, 2012). The “nested, decentralized” (Holst and Rasmussen, 2012, p. 269) organization of barrow construction may be a good model for organization in the heathland, with relatively independent herder groups operating within the landscape, but with a shared overall goal.

Unlike the rundale, this was not a system with significant space pressure. Indeed, the heathlands were vast, open and uncontrollable. Collective action in these arenas has many similarities with the expectations established in Ostrom’s (1990) design principles for commoning, yet there are significant divergences too. Most notably, the sheer scale and mobility of this system leaves no scope to argue for a tightly controlled resource to which access could practically

be limited. Instead, obligations and responsibilities in these pastures seem to have been secured by the critical presence of the ancestral dead. Barrow construction was a critical point for inter-community cooperation (Holst and Rasmussen, 2012), and this seems to have extended into the pastoral system which they supported, a kind of “ancestral commons” (Houghton and Løvschal, 2023, 2024). The similar presence of ritual elements within the rundale system (Lash, 2023, 2024) is a reminder that collective action may rely more frequently on cosmological forces than is generally recognized.

Barrow construction was particularly important not just in fostering community cooperation, but also in strengthening the ideological precepts that underlay landscape management. Another crucial activity which brought communities together in these landscapes was the prescribed burning of aged heathland. This was a necessary practice to stop forest succession and to preserve palatability of heather for animals. It requires specialist knowledge to carry it out and to assess when the conditions required it (Gimingham, 1993). As the visual language of barrows depends on an open landscape to maintain visibility, the needs of animals and the needs of ancestors were one and the same.

As such, the trajectory of settling down and the creation of Danish heathlands was one which was guided and constrained by animals. Heavy involvement in animal tasks, such as taking herds out to pasture or engaging in the long and largely sedentary process of producing woolen textiles, significantly affected both how people experienced the annual cycle and created the opportunity for lines of social difference in the population. While these may have been articulated in human terms, they were, at least in significant part, the result of relations with and demands of animals.

Collective animals: the Bronze Age Carpathian Basin

“I see the grass through the mouths of my animals,” a Hungarian proverb told to Molnár (2017, p. 522).

With a lengthy period of stable grasslands ideal for animal husbandry (Röpke, 2021, p. 248), pastoralism was the backbone of Middle Bronze Age “tell” societies in the Carpathian Basin (MBA: 2000/1900–1500/1450 cal BC; Bartosiewicz, 2013; Gál, 2017; Vretemark and Sten, 2020). One such region was the Benta Valley, lying southwest of Budapest, running northwest from the MBA tell of Százhalombatta-Földvár on the west bank of the Danube (Figures 5, 6). Százhalombatta was one of many multi-layered settlements built on loess promontories along the Danube and Tisza rivers and their tributaries, the subject of ongoing excavation for 35 years (Poroszlai, 2000; Poroszlai and Vicze, 2000, 2005). As excavation has been focused on the densely populated village, pastoralist practices have been only vaguely outlined. Further consideration is required to explore how animal husbandry was organized between people and animals on the landscape, or between nearby communities, and how it affected social relations and political formations.

Previous research suggested that Százhalombatta was the center of a “chiefdom-like” polity with a three-tiered settlement pattern in the Benta Valley, where pastoralism was the domain of “unfortified, satellite” settlements that provided livestock for “fortified” centers as tribute, “as ready cut-out pieces” (Earle and Kristiansen, 2010, p. 222; Figure 5). However, the recent synthesis of zooarcheology at Százhalombatta indicates otherwise. Sheep were dominant (possibly

wooly sheep in the later MBA, Sabatini et al., 2019, p. 4,919), followed by multipurpose meat, dairy, and draught cattle, pigs, dogs (Vretemark and Sten, 2020), and horses (Kanne, 2018, 2022). All body parts for cattle, ovicaprids, and pigs were recovered in the village; all ages of animals present, from neonates to very old animals; and dogs gnawed these bones (Vretemark and Sten, 2020). Not only slaughter and processing occurred at Százhalombatta, but livestock breeding was very near to the village, with some animals possibly housed within or abutting the enclosure, like dairy and transport animals. Many livestock survived into old age. People would have had long-term, regular interactions with known individuals. Novel, quotidian, and close relationships between people and animals, were changing the dynamics of human-animal labor, adding to the expectations of collaboration between all parties, including riding horses, shearing sheep, and driving and milking cattle. Though no penning has been found on the tell, nor evidence of animals within households (Kovács et al., 2020; Sørensen et al., 2020, p. 15), over half the tell was lost to clay extraction. New methods to discern animal habitation elsewhere have not yet been applied, though phosphorus analysis from the center of the village to outside of the ditch documented high levels of human/animal activity, with the highest results at 2 m and 50 m outside it (Füleky et al., 2015), consistent with close animal occupation.

Rather than exclusively supported by smaller villages, commoning of livestock for the households at Százhalombatta-Földvár is a probable scenario, occurring very near the settlement in the Benta Valley (Figure 5). The valley was dominated by grasslands and pastoralism, supported by arable agriculture, with lush grazing areas on its slopes (French, 2010, p. 46, Plate 2.4). Unlike the more marginally sited commons of Irish rundale and Bronze Age Denmark, four fertile landscapes, including floodplain, the floodplain and forested margin, the slopes, and the hills beyond, provided excellent grazing for different times of the year (French, 2010). Animal remains excavated from the tell document sizable herds, with an estimated 90 cattle, 160 caprines, and 90 pigs slaughtered annually for the 300 residents (Vretemark, 2010, p. 168). To maintain viable breeding populations, the living-stock required to feed and supply the tell with secondary products likely numbered between 750 to several thousand animals. A “truncated catchment area” is assumed for Százhalombatta as the Danube halved the typical catchment radius. While true, possible stocking rates on the rich floodplains and hilly meadows are considerably lower than even a 2.5km² area could sustain¹ (c.f., Stobbe et al., 2016; Figure 6).

Labor, not land, was limited. The number of livestock, and many different herd classes, required supra-household assistance. As in rundale, this was an arena for building and maintaining collaborative

1 The Benta Valley sites lie on extremely fertile loess chernozem soils within the four zones outlined above. Following Stobbe et al. (2016) for roughly comparable sites and environment, a catchment of 250ha (2.5km²), Százhalombatta could maintain from 1,526 LSU at 0.16/LSU/ha (LSU=Livestock Unit: 1 LSU=1 dairy cow, 0.8 horse, 0.1 ovicaprid, 0.5 breeding sow) to 500 at 0.5/LSU/ha, and with a 400ha catchment (4km²), 2,500 at 0.16/LSU/ha and 800 at 0.5/LSU/ha. Fording animals across the Danube to Csepel Island, where there were no MBA villages could be another possibility, given the rich floodplain grazing. Moving stock via barges to grazing lands and in trade is considered to have been practiced from the Neolithic (e.g., Case, 1969; Cummings and Morris, 2022).

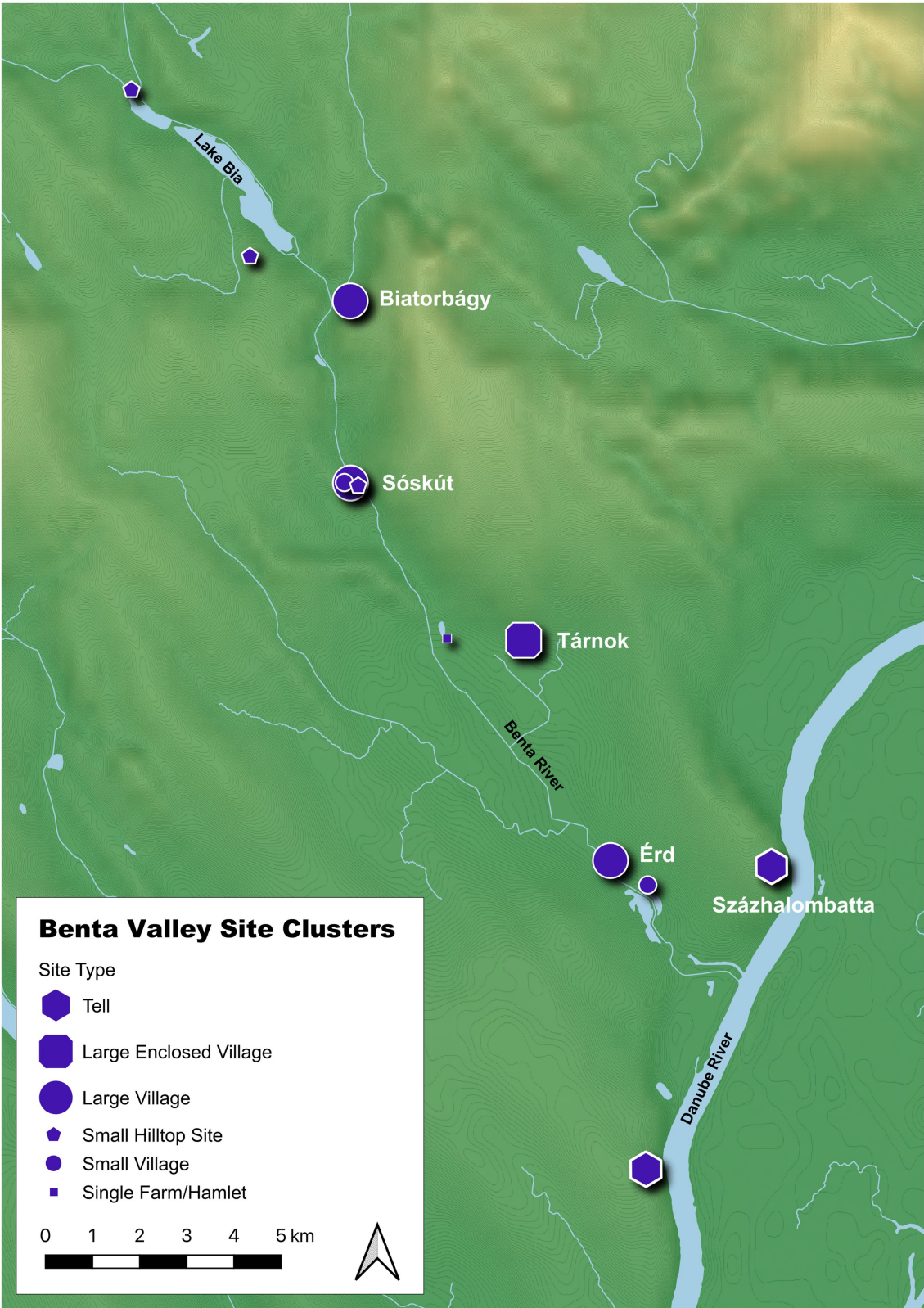


FIGURE 5
Map of sites in the Benta Valley, based on Kanne’s maps in [Earle and Kristiansen \(2010\)](#). Site types also from [Earle and Kristiansen \(2010\)](#), updated to reflect recent research ([Szeverényi and Kulcsár, 2012](#); [Szeverényi et al., 2017](#); [Kulcsár et al., 2020](#)). The even distribution of these site clusters with ample open grazing between them, suggests commons surrounding each, probably within the 4 km distance for water suggested for sheep (8 km for cattle) or a catchment of roughly 4 km ([Stobbe et al., 2016](#)).

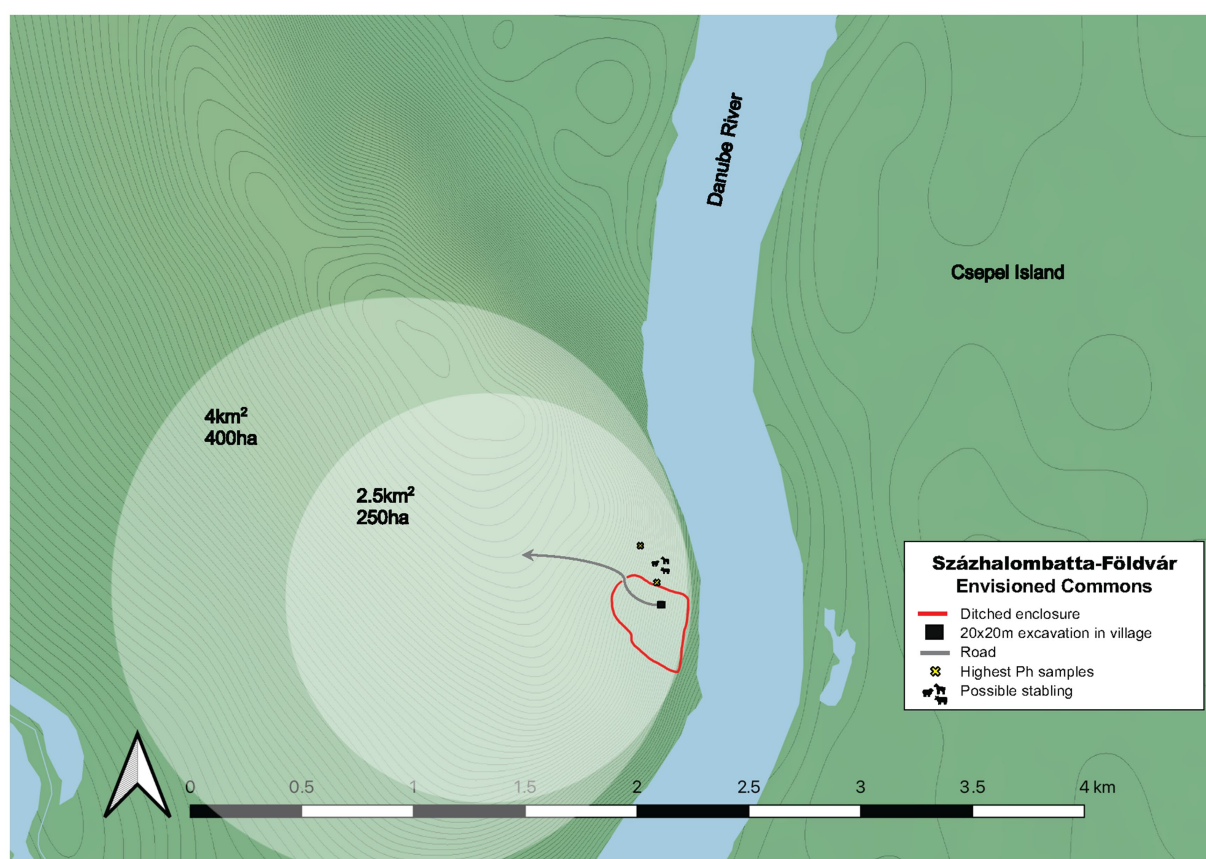


FIGURE 6

Envisioned commons at Százhalombatta-Földvár. Circles represent catchment areas of 4 km² or 400 ha and 2.5 km² or 250 ha, which could have been arranged in a number of ways to provide fresh graze for the multiple herd classes at the tell without encroaching on other settlement's commons up the Benta Valley. These commons could have supported between 1,526 LSU at 0.16/LSU/ha (LSU, Livestock Unit: 1 LSU = 1 dairy cow, 0.8 horse, 0.1 ovicaprid, 0.5 breeding sow) to 500 at 0.5/LSU/ha, and with a 400 ha catchment (4 km²), 2,500 at 0.16/LSU/ha and 800 at 0.5/LSU/ha. Fording animals across the Danube to Csepel Island, where there were no MBA villages could be another possibility, given the rich floodplain grazing. Moving stock via barges to grazing lands and in trade is considered to have been practiced from the Neolithic (e.g., Case, 1969; Cummings and Morris, 2022).

social relationships based around herding, affording ample opportunities to monitor others for compliance with commoning arrangements. The daily taskscape of pastoralism included protecting livestock in common pastures from predators and thieves, probably with dogs and horses, milking dairy animals, and moving working and dairy livestock to and from pasture, from stabling either abutting or possibly within the enclosure. Face-to-face interactions organized routine, repeat journeys for people and animals, dividing labor by herd divisions of species, age, and class, while others trained, rode, and drove traction animals. Animals with complementary preferences, like cattle and sheep, grazed together, further split between dry and milk herds, young and breeding stock. Pigs would have been left to roam the forest at the margins of the floodplain, with herders moving other stock based on breeding cycles, just before slaughter, and seasonally between the low ground and agricultural fields in the winter, and hills and slopes from spring to autumn. A reliable network of cooperating herders pooling labor utilized the unenclosed common grazing areas outside of the ditch on the sloping hills and floodplain in the Benta Valley, and along or maybe across the Danube onto Csepel Island, perhaps in an infield-outfield system (Figure 6).

Given large villages, about 5 km apart from each other up the Benta Valley, with population estimates up to 1,700 people in 50 km², a

sophisticated system of commoning agreements between communities must have been in place to maintain the relative peace that lasted for centuries (Figure 5). Effective management of common grazing needed leadership from each herding group, and from each village to organize, matching the mortuary evidence of senior members of the society buried with slightly more grave goods than others, perhaps heading a segmentary organization (Laabs, 2023). Mortality profiles and mobility isotopes demonstrate that a few horses were imported and exported from the Benta Valley, ridden by adolescents and adults of both sexes for herding and travel (Kanne, 2022). Exchange of livestock, mates, and goods must have been important to secure ties between herding groups, between communities, and with extra-regional trading partners. This is borne out by evidence of regional and supra-regional exchange in distinctive pottery and horses. Százhalombatta received bronze, amber, and other goods in long-distance trade (Earle and Kristiansen, 2010; Kristiansen and Earle, 2015; Vandkilde, 2016; Ling et al., 2018).

Recent interpretations of tell societies finds they were more heterogeneous and decentralized politically, with less evidence for social differentiation in house size, material culture, or mortuary practices, or of elite control of agropastoral surplus, horses, bronze production, or craft specialization (Bartelheim, 2009; Sørensen, 2010; Earle et al., 2011; Kienlin, 2015; Klehm and Nyíri, 2016; Kienlin et al., 2017; Dani et al.,

TABLE 2 Measures of collective action in the case studies.

Measures of collective action in the commons	Rundale Ireland	EBA Jutland	MBA Hungary
Group Size	Small	Mostly small	Small
Social Homogeneity	High	Moderate–High	High
Communal Labor	Seasonal	Seasonally High	High
Boundaries	Infield-Outfield	None in heathland	Partial
Livestock > household	Equal	Greater than	Greater than
Commons seasonality	Year round and seasonal	Seasonal	Year round
Arable agriculture to pastoralism	Arable farming is primary, but interdependent with pastoral farming	Secondary to arable farming	Secondary to arable farming
Domesticated species abundance	Primarily cattle with sheep, goats, and pigs	Primarily cattle and sheep/goat, abundances unclear	Caprine heavy, multiple cattle and caprine classes, pigs, horses, dogs
Species products	Meat, dairy, wool, traction	Meat, dairy, wool, traction surplus for trade	Meat, dairy, wool, traction, surplus for trade
Settlement type	Village	Single or paired farmstead	Village
Land quality/commons management	Marginal/Intensive	Marginal/Extensive	Excellent/Mid-range
Levels of bureaucracy/leadership	An Ri (king) and local council, external authorities including estate agent, landlord, and judicial courts	No evidence for bureaucracy; local leadership possible	Achieved leadership, levels of bureaucracy low, but trade and craft suggest different occupations
Extent of the trade of animals or secondary products	Trade within the village and larger markets	Extensive, long-distance trading of wool or sheep	Between households, herding groups, villages, region, extensive, long-distance
Land or Labor Limited	Land	Labor initially; land later	Labor
Excludability	High	Low	Medium
Subtractability	High	High	Medium

2018, 2019; Fischl, 2018; Jaeger, 2018; Quinn and Ciugudean, 2018; Duffy et al., 2019; Gävan, 2019; Kanne, 2022; Laabs, 2023). Three-tiered settlement hierarchies for tell polities cannot be taken as evidence for unequal relations between settlements, regional political consolidation, or control of trade and craft production (Duffy, 2015; Gogăltan, 2017). Rather than necessarily defensive, large ditched enclosures also occur on large single-layer settlements, like Tárnok (Earle et al., 2014; Kienlin et al., 2017; Jaeger, 2018; Dani et al., 2019). Ditches may have held symbolic meaning for defining the community (Szeverényi and Kulcsár, 2012; Gogăltan, 2017), aided in keeping livestock in or out of the village, and managing marshy environments, as they are accepted to do in Britain (Randall, 2021) and the Netherlands in the Bronze Age (Arnoldussen and Fokkens, 2008). Ditch construction needed communal labor, as did the extensive clearance of the landscape for pastoral use (Magyari et al., 2010, p. 296). A roadway with wheel ruts, presumably from ox-drawn wagons, led into Százhalombatta, and provided access beyond it (Vicze et al., 2014). Like the ditch, the road was rebuilt several times with communal labor to maintain this public good. The road, ditch, and commons were co-jointly produced and inhabited animal architectures important for identifying, organizing, and creating this more-than-human community.

Discussion

With these cases, we centered our analyses on the taskscape of sedentary animal husbandry to reveal the spatially embedded social relationships resulting in the commons as an institution. As modeled,

collective action was realized variably in each case, and affected the ways they were governed (Table 2).

Rundale relied on the management of common resources by collectives of tenants engaged in agropastoralism generating products for subsistence and rent. Villages under rundale were small-scale networks of collective action subsumed within a wider system of colonial and capitalist extraction. Inequalities of wealth and influence existed within rundale villages, yet these were relatively small and homogenous social units, composed of households linked through shared descent, religion and cosmology, and conventions of sociality, indicating a degree of excludability. The viability of collective action in rundale relied partly on its articulation with other social institutions, particularly kinship, ritual, and reciprocity. While the system focused on the staple subsistence crop of potatoes, arable and pastoral taskscape were interdependent and reliant on common resources. Headmen adjudicated disputes and helped negotiate the use and redistribution of land because of its high subtractability in these marginal landscapes. With partible inheritance and high population densities, land was more limited than labor. This, and the perennial problem of animal trespass, could challenge the stability of collective action and generate conflict. Nevertheless, constraints and control exerted by external authorities—estate agents, landlords, and colonial governance—accounted for the vulnerability of rundale villages, most notoriously the great hunger of the mid-19th century, and the subsequent erosion of collective agriculture and joint-tenancy agreements.

The heathlands of Bronze Age Denmark skew to the other end of the spectrum, where excludability was nearly impossible. The communal

labor of barrow building and commons maintenance required collective action between people and between people and animals, whose routines layered the landscape with routes of remembrance and rebirth for grazing. This coordination required households to manage activities over long distances, split between sedentary and pastoral tasks for portions of the year. Indeed, the settlement pattern seems to contradict the coordination necessary for heathland maintenance and barrow construction, indicating that households were generally relatively independent, and group size was small. Nevertheless, they clearly cooperated to produce and maintain the vast heathland resource. The critical difference was the permanent presence of the ancestral dead, providing a strong coercive force to encourage particular behaviors (Haughton and Løvschal, 2024). Otherwise, these landscapes are devoid of evidence for leadership or control, and any form of administrative bureaucracy. Animals played pivotal roles in both maintenance and expansion of heathland keeping growing shrubs and trees under control for a time, before the older, unpalatable heather necessitated burning, and both motivating further expansion and, in the case of cattle at least, probably causing it by disrupting trees. Given the vast scale of the grazing landscape, this was a labor-limited system, at least in its initial instantiation. However, the very practices which gave the system its persistence also impinged upon it: barrows, usually constructed from heathland turf, devoured large areas of pasture (Holst and Rasmussen, 2013). Ultimately, a decentralized system, originally labor-limited, was transformed into an unsustainable land-limited one, vulnerable to increasing inequalities.

In the MBA Benta Valley, excludability was possible, while subtractability was less than the other cases, remaining sustainable for centuries. Nucleated villages and enclosed settlements within 5–10 km of each other, and the number of livestock of different classes, necessitated coordination within households, between herding groups, and between neighboring communities, leading to the more communal ethos evident in houses, material culture, and burial. Labor was limiting; land was not. The commons was an institution that organized social and spatial relationships. Collective governance perhaps emerged from the institutional commons, reinforced by the communal labor required for ditch digging and road building and maintenance. The benefits of herding cooperatively freed some household members for other activities, either related to livestock products, like milk and wool processing, to arable agriculture, pottery making, and long-distance trade. In the terminal MBA (1600–1500/1450 cal BC), increasing trade and bronze hoarding in rivers and fording sites suggests there may have been some aiming to assert political authority, and society was becoming more hierarchically and centrally organized (Polányi, 2022). However, the tells were depopulated before reorganizing in the Late Bronze Age.

Summary

Animals made sedentism possible from at least the beginning of the Holocene (Zeder and Lemoine, 2023). To settle down with animals was, and is, inescapably social. The relational sociality required by domestication, and in “secondary product” processes, requires interspecies communication and coordinated labor, resulting in practical norms between people and animals that are institutionalized in the commons. Different kinds of social, spatial, political organizations develop from the increased proximity and close interactions with livestock throughout the Neolithic into the Bronze

Age. Collective action is hard, but so is pastoralism. The commons arise as a solution to cooperator problems between people and animals, which leads to distinctly animal directed and oriented solutions for settlement planning and labor, requiring collective action, such as those in the Danish heathlands and surrounding nucleated settlements in the Carpathian Basin, both of which had long periods of more decentralized, collective political formations that lasted until the latter centuries of the second millennium BC.

Through the interdependencies of regular co-labor, the durability of the commons as institution, as well as its typical features, were etched on landscapes, embedded in genetic and isotopic signatures in bones and teeth of people and livestock, and connected by their shared genealogies and histories. Daily, seasonal, and yearly life cycles of animals informed the taskscape of agropastoralism, structuring settlement patterns, social relations, and political authority. The brief examples we have presented demonstrate how this co-laboring can produce subtly different forms of collective action in different communities, a legacy not just of environmental conditions but also of social formations. New forms of spatially embedded social relationships emerged in sedentarization and the ensuing commons. The embodied know-how of raising animals offers opportunities for both reiterating and fracturing social bonds. Labor arrangements of the commons allow for other activities to occur, such as craft specializations, which could fund emergent political economies.

Sedentary animal husbandry was more likely to be embedded in and induce inequality when fewer people had more livestock, especially in land limited areas. When dispersed or differentially placed farmsteads did not rely on neighbors to manage grazing and water resources, some people could amass more livestock than less well-placed neighbors. At the end of the Bronze Age, land became increasingly demarcated with linear boundaries, enclosed farmsteads, and field divisions in southern Scandinavia (Løvschal and Holst, 2014), and became defended within heavily fortified settlements in the Carpathian Basin (Szevérenyi et al., 2017; Molloy et al., 2020). Though in southern Scandinavia, this newly demarcated landscape was initially equally distributed to mitigate inequalities, the conditions were created where differentiation became possible, a double-edged materiality that could engender collective governance, but also make hierarchical authority achievable (Løvschal, 2020). Increasingly formalized land tenure in northwest Europe in the Bronze Age (Løvschal, 2020, p. 371, 372) became regularized across Europe, with later prehistoric land demarcation corresponding to increasing social hierarchy (Griffiths et al., 2022), placing the commons in societies with more exclusionary rule. As property rights were asserted, land and animals were owned by fewer people, or commons became part of extractive systems of land tenure. Our reappraisal of the trend in Bronze Age sedentism with respect to animal management follows recent efforts illustrating the differences between labor- and land-limited economies, the latter of which are associated with greater persistent wealth disparities (Bogaard et al., 2019).

Concluding thoughts

Animals made a critical difference in settling down. The institutional commons develop with sedentism to meet animal requirements in particular landscapes, and, through its organization, fundamentally affects the spatial and sociopolitical organization of complex societies. Animals are participants in this institution, and

can be participants in collective action because they demand coordination and cooperation in labor and cohabitation. These institutional requirements induce collective action, initially resulting in more collectively governed and decentralized societies, as in the earlier Bronze Age examples, or be a collective (and also extractive) institution couched in more vertically arranged political institutions, as the case of 19th-century Irish rundale, and later Bronze and Iron Age institutions.

New methods can aid in understanding sedentary animal husbandry and the dynamics of commons in prehistory. Ancient DNA, alongside mobility and dietary isotopes, have the potential to link animals and people together in migration, exchange, travel, genealogies, and social relationships. Establishing livestock presence within prehistoric commons, and distinguish activity areas and movements on the landscape, is improving rapidly with high-resolution techniques. As such, holistic conceptualizations accounting for multidirectional cooperation between people and more other-than-human actors, should be attempted.

Flying back and forth from Ireland, England, Denmark and further to the States and eastern Europe, we look down at the striking volume of land occupied by domesticated crops, largely to feed animals, along with the open pastures and hedgy, stony patchworks of pastures enclosing cattle, horses, sheep and goats. The landscape is utterly dominated by domesticates; the biomass of just cattle, pigs, and chickens vastly outnumbers the biomass of people and all wild species (Bar-On et al., 2018). This begs the question, whose landscapes are we living in? Is it the people concentrated in areas organized with eyes to markets and transport? Or is it the animals, whose needs take up the majority of habitable land? The point is that it's *our* landscape, *our* world—the one that we negotiated and managed into existence together.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

References

- Aalen, F. H. A., Whelan, K., and Stout, M. (1997). *Atlas of the Irish rural landscape*: University of Toronto Press.
- Adcock, S. E. (2022). Collapse, complexity, and caprines: Zooarchaeological investigations of the Hittite state and its afters. *J. Anthropol. Archaeol.* 68:101465. doi: 10.1016/j.jaa.2022.101465
- Aldred, O. (2020). *The archaeology of movement*: Routledge.
- Allentuck, A. (2015). Temporalities of human–livestock relationships in the late prehistory of the southern Levant. *J. Soc. Archaeol.* 15, 94–115. doi: 10.1177/1469605314546071
- Andersen, S. T. (1998). Pollen analytical investigations of barrows from the Funnel Beaker and Single Grave Cultures in the Vroue area, West Jutland, Denmark. *J. Danish Archaeol.* 12, 107–131. doi: 10.1080/0108464X.1995.10590089
- Anderson, D. G., Looovers, J. P., Schroer, S. A., and Wishart, R. P. (2017). Architectures of domestication: on emplacing human–animal relations in the North. *J. R. Anthropol. Inst.* 23, 398–416. doi: 10.1111/1467-9655.12613_1
- Angelbeck, B., and Grier, C. (2012). Anarchism and the archaeology of anarchic societies: resistance to centralization in the Coast Salish region of the Pacific Northwest Coast. *Curr. Anthropol.* 53, 547–587. doi: 10.1086/667621
- Arbuckle, B. S. (2012). Animals and Inequality in Chalcolithic Central Anatolia. *J. Anthropol. Archaeol.* 31, 302–313. doi: 10.1016/j.jaa.2012.01.008
- Arbuckle, B. S. (2014a). The Rise of Cattle Cultures in Bronze Age Anatolia. *J. Eastern Mediterr Archaeol Heritage Stud.* 2, 277–297. doi: 10.5325/jeasmedarcherstu.2.4.0277

Author contributions

KK: Conceptualization, Writing – original draft, Writing – review & editing. MH: Writing – original draft, Writing – review & editing. RL: Writing – original draft, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. KK was supported by the European Research Council (ERC) under the European Union's Horizon Europe Research and Innovation Program (grant agreement no. 101055195). MH was supported by the ERC under the European Union's Horizon 2020 Research and Innovation Program (grant agreement no. 853356). RL was supported by an Irish Research Council Postdoctoral Fellowship (GOIPD/2021/160).

Acknowledgments

KK wishes to thank Rich Blanton, Poco, Lane Fargher, and Verence Heredia Espinoza for long conversations about collective action and institutions from our shared time at Purdue University, the ANSOC team, especially Joanna Brück. MH thanks the ANTHEA project team, particularly Mette Løvschal. RL would like to thank Simon Murray, Tommy Burke, and John Burke for sharing their time and their farmwork. He is grateful to all the people on Inishbofin who have shared their experiences of farming with him.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Arbuckle, B. S. (2014b). "Inequality and the Origins of Wool Production in Central Anatolia" in *Animals and Inequality in the Ancient World*. eds. B. S. Arbuckle and S. A. McCarty (Boulder: University Press of Colorado), 209–229.
- Arbuckle, B. S., and Hammer, E. J. (2019). The Rise of Pastoralism in the Ancient Near East. *J. Archaeol. Res.* 27, 391–449. doi: 10.1007/s10814-018-9124-8
- Arnoldussen, S., and Fokkens, H. (2008). *Bronze Age Settlements in the Low Countries*. Oxford: Oxbow Books.
- Banham, D., and Faith, R. (2014). *Anglo-Saxon farms and farming*. Oxford: Oxford University Press.
- Bar-On, Y. M., Phillips, R., and Milo, R. (2018). The biomass distribution on Earth. *Proc. Natl. Acad. Sci.* 115, 6506–6511. doi: 10.1073/pnas.1711842115
- Bartelheim, M. (2009). "Elites and metals in the Central European Early Bronze Age" in *Metals and societies* Universitätsforschungen zur Prähistorischen Archäologie. eds. T. L. Kienlin and B. W. Roberts (Bonn: Verlag Dr. Rudolf Habelt GmbH), 34–46.
- Bartosiewicz, L. (2013). "Animals in Bronze Age Europe" in *The Oxford Handbook of the European Bronze Age*. eds. H. Fokkens and A. Harding (Oxford: Oxford University Press), 328–347.
- Beaujouan, J., Cromer, D., and Boivin, X. (2021). Review: From human–animal relation practice research to the development of the livestock farmer's activity: an ergonomics–applied ethology interaction. *Animal* 15:100395. doi: 10.1016/j.animal.2021.100395
- Bech, J. H., Kristiansen, K., and Eriksen, B. V. (2018). *Bronze Age Settlement and Land-Use in Thy, Northwest Denmark (Volume 1 & 2)*, vol. 102. Aarhus: Universitetsforlag.
- Bell, J., and Watson, M. (2008). *A history of Irish Farming 1750–1950*. Dublin: Four Courts Press.
- Bernbeck, R. (2008). "An archaeology of multi-sited communities" in *The archaeology of mobility: Old World and New World nomadism*, 43–77.
- Birch, S. E. (2018). "Introduction" in *Multispecies Archaeology*. ed. S. E. Pilar Birch (Abingdon, Oxon; New York, NY: Routledge), 1–8.
- Black Trowel Collective/Berihuete-Azorin, M., Blackmore, C., Borck, L., Flexner, J. L., Frieman, C. J., et al. (2024). Archaeology in 2022: Counter-myths for hopeful futures. *Am. Anthropol.* 126, 135–148. doi: 10.1111/aman.13940
- Blanton, R. E. (2016). "The Contingent Cooperator as Seen from the Perspectives of Neurobiology and Bioevolution" in *How humans cooperate: Confronting the challenges of collective action*. eds. R. E. Blanton and L. Fargher (Boulder, CO: University Press of Colorado), 57–68.
- Blanton, R. E., and Fargher, L. (2016). *How humans cooperate: Confronting the challenges of collective action*. Boulder, CO: University Press of Colorado.
- Blanton, R. E., Feinman, G. M., Kowalewski, S. A., and Fargher, L. F. (2022). Origins, foundations, sustainability and trip lines of good governance: Archaeological and historical considerations. *Front. Polit. Sci.* 4:983307. doi: 10.3389/fpos.2022.983307
- Bogaard, A., Allaby, R., Arbuckle, B. S., Bendrey, R., Crowley, S., Cucchi, T., et al. (2021). Reconsidering domestication from a process archaeology perspective. *World Archaeol.* 53, 56–77. doi: 10.1080/00438243.2021.1954990
- Bogaard, A., Bowles, S., and Fochesato, M. (2019). The farming-inequality nexus: new insights from ancient Western Eurasia. *Antiquity* 93, 1129–1143. doi: 10.15184/aqy.2019.105
- Boivin, N. L., Zeder, M. A., Fuller, D. Q., Crowther, A., Larson, G., Erlandson, J. M., et al. (2016). Ecological consequences of human niche construction: Examining long-term anthropogenic shaping of global species distributions. *Proc. Natl. Acad. Sci.* 113, 6388–6396. doi: 10.1073/pnas.1525200113
- Borgerhoff Mulder, M., Bowles, S., Hertz, T., Bell, A., Beise, J., Clark, G., et al. (2009). Intergenerational wealth transmission and the dynamics of inequality in small-scale societies. *Science* 326, 682–688. doi: 10.1126/science.1178336
- Borgerhoff Mulder, M., Bowles, S., and Smith, E. A. (2010). The emergence and persistence of inequality in premodern societies: introduction to the special section. *Curr. Anthropol.* 51, 7–17. doi: 10.1086/649206
- Boyd, B. (2017). Archaeology and Human–Animal Relations: Thinking Through Anthropocentrism. *Ann. Rev. Anthropol.* 46, 299–316. doi: 10.1146/annurev-anthro-102116-041346
- Brusgaard, N. Ø., Fokkens, H., and Kootker, L. M. (2019). An isotopic perspective on the socio-economic significance of livestock in Bronze Age West-Frisia, the Netherlands (2000–800 BCE). *J. Archaeol. Sci. Rep.* 27:101944. doi: 10.1016/j.jasrep.2019.101944
- Bumochir, D., Ichinkhorloo, B., and Ahearn, A. (2020). Herd Agency: Rethinking Herd–Herder Relations in Mongolia and Qinghai, China. *Inner Asia* 22, 183–198. doi: 10.1163/22105018-12340146
- Burentogtokh, J. (2017). *Pastoralists, communities, and monumentality during the Mongolian Bronze Age*. New Haven, CT: Yale.
- Caffentzis, G., and Federici, S. (2014). Commons against and beyond capitalism. *Commun. Dev. J.* 49, i92–i105. doi: 10.1093/cdj/bsu006
- Caramanica, A., Corcoran-Tadd, N., and Price, M. (2023). The Political Economy of Livestock in Early States. *Camb. Archaeol. J.* 33, 119–136. doi: 10.1017/S095977432200021X
- Carballo, D. M., and Feinman, G. M. (2023). *Collective Action and the Reframing of Early Mesoamerica*. Cambridge: Cambridge University Press.
- Carrer, F., Mocchi, F., and Walsh, K. (2015). Ethnoarchaeology of western alpine upland landscapes: preliminary results. II Capitale Culturale: Studies on the Value of Cultural Heritage 12.
- Carvajal Castro, A. (2021). Early Medieval Commons? Or How the History of Early Medieval Europe Could Benefit from a Necessary Conversation: The Case from NW Iberia. *Int. J. Commons* 15, 338–353. doi: 10.5334/ijc.1109
- Case, H. (1969). Neolithic explanations. *Antiquity* 43, 176–186. doi: 10.1017/S0003598X00040448
- Catháin, Ó., and O'Flanagan, P. (1975). *The Living Landscape: Kilgalligan, Erris County Mayo*. Dublin: Comhairle Bhéaloideas Éireann, An Coláiste Ollscoile.
- Chang, C. (2017). *Rethinking prehistoric Central Asia: Shepherds, farmers, and nomads*. Routledge.
- Chang, C., and Koster, H. A. (1986). Beyond bones: toward an archaeology of pastoralism. *Adv. Archaeol. Method Theory* 9, 97–148. doi: 10.1016/B978-0-12-003109-2.50006-4
- Chatterton, P., and Pusey, A. (2020). Beyond capitalist enclosure, commodification and alienation: Postcapitalist praxis as commons, social production and useful doing. *Prog. Hum. Geogr.* 44, 27–48. doi: 10.1177/0309132518821173
- Chazin, H. (2023). Animal work before capitalism: Sheep's reproductive labor in the ancient South Caucasus. *Am. Anthropol.* 125, 809–823. doi: 10.1111/aman.13916
- Connell, K. H. (1950). *The population of Ireland, 1750–1845*. Dublin: Greenwood Press.
- Costello, E. (2017). Liminal learning: social practice in seasonal settlements of western Ireland. *J. Soc. Archaeol.* 17, 188–209. doi: 10.1177/1469605317708378
- Costello, E. (2020). Transhumance and the Making of Ireland's Uplands, 1550–1900: Boydell & Brewer.
- Costello, E., and Svensson, E. (2018). *Historical archaeologies of transhumance across Europe*. London: Routledge.
- Cribb, R. (1991). *Nomads in archaeology*. Cambridge: Cambridge University Press.
- Cucchi, T., and Arbuckle, B. (2021). Animal domestication: from distant past to current development and issues. *Anim. Front.* 11, 6–9. doi: 10.1093/af/vfab013
- Cummings, V., and Morris, J. (2022). Neolithic Explanations Revisited: Modelling the Arrival and Spread of Domesticated Cattle into Neolithic Britain. *Environ. Archaeol.* 27, 20–30. doi: 10.1080/14614103.2018.1536498
- Cunliffe, B. (2004). *Iron Age communities in Britain: an account of England, Scotland and Wales from the seventh century BC until the Roman conquest*. London: Routledge.
- Daly, K. G., Mattiangeli, V., Hare, A. J., Davoudi, H., Fathi, H., Doost, S. B., et al. (2021). Herded and hunted goat genomes from the dawn of domestication in the Zagros Mountains. *Proc. Natl. Acad. Sci.* 118:e2100901118. doi: 10.1073/pnas.2100901118
- Danachair, C. Ó. (1981). An Rí (The King) an Example of Traditional Social Organisation. *J. R. Soc. Antiqu. Irel.* 111, 14–28.
- Dani, J., Fischl, K., Kiss, V., Kulcsár, G., and Szeverényi, V. (2019). "Dividing space, dividing society: fortified settlements in the Carpathian Basin" in *Late Neolithic and Early Bronze Age Settlement Archaeology Band 20/2*. eds. H. Meller, S. Friederich, M. Küfner, H. Stäuble and R. Risch (Halle: Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt – Landesmuseums für Vorgeschichte Halle), 851–868.
- Dani, J., Márkus, G., Bálint, M., and Bacskai, I. (2018). "Middle Bronze Age settlement network in the neighbourhood of Polgár" in *Proceedings of the Settlement Layouts, Systems and Structure of the Otomani-Füzesabony Cultural Complex*. ed. K. Fischl (Miskolc: Gesta), 127–146.
- deFrance, S. (2009). Zooarchaeology in Complex Societies: Political Economy, Status, and Ideology. *J. Archaeol. Res.* 17, 105–168. doi: 10.1007/s10814-008-9027-1
- DeMarrais, E., and Earle, T. (2017). Collective action theory and the dynamics of complex societies. *Ann. Rev. Anthropol.* 46, 183–201. doi: 10.1146/annurev-anthro-102116-041409
- Duffy, P. R. (2015). Site Size Hierarchy in Middle-Range Societies. *J. Anthropol. Archaeol.* 37, 85–99. doi: 10.1016/j.jaa.2014.12.001
- Duffy, P. R., Paja, L., Parditka, G. M., and Giblin, J. I. (2019). Modeling mortuary populations at local and regional levels. *J. Anthropol. Archaeol.* 53, 240–261. doi: 10.1016/j.jaa.2019.01.003
- Earle, T. K., Kreiter, A., Klehm, C., Ferguson, J., and Vicze, M. (2011). Bronze Age Ceramic Economy: The Benta Valley, Hungary. *Eur. J. Archaeol.* 14, 419–440. doi: 10.1179/146195711798356746
- Earle, T. K., and Kristiansen, K. (2010). *Organizing Bronze Age Societies: The Mediterranean, Central Europe, and Scandinavia Compared*. New York: Cambridge University Press.
- Earle, T. K., Kulcsár, G., Kiss, V., Serlegi, G., and Szeverényi, V. (2014). Recent results from the Bronze Age research into the Benta Valley. Magyar Régészet/Hungarian Archaeology, 2. Available at: http://files.archaeolingua.hu/2014NY/Upload/cikk_Earle_EN.pdf

- Ebersbach, R. (2010). "My farmland—our livestock: forms of subsistence farming and forms of sharing in peasant communities" in *The Principle of Sharing, Segregation, and Construction of Social Identities at the Transition from Foraging to Farming*. ed. M. Benz (Berlin: Ex-Oriente), 159–182.
- Ebersbach, R. (2013). "Quantitative approaches to reconstructing prehistoric stock breeding" in *Economic archaeology: from structure to performance in European archaeology* (Bonn: Habelt), 143–160.
- Elliott, S., and Matthews, W. (2023). Dung detective! A multi-scalar, multi-method approach to identification and analysis of ancient faecal material. *Quat. Int.* 683, 162–181. doi: 10.1016/j.quaint.2023.02.005
- Evans, C., Appleby, G., and Lucy, S. (2016). *Lives in land. Mucking excavations by Margaret and Tom Jones 1965–1978: Prehistory, context and summary*. Oxford: Oxbow Books.
- Evin, A., Bouby, L., Bonhomme, V., Jeanty, A., Jeanjean, M., and Terral, J.-F. (2022). Archaeophenomics of ancient domestic plants and animals using geometric morphometrics: a review. *Peer Commun J* 2:e27. doi: 10.24072/pcjournal.126
- Feehan, J. (2012). "The potato: root of the Famine" in *Atlas of the Great Irish Famine*. eds. J. Crowley, W. J. Smyth and M. Murphy (New York: NYU Press), 28–40.
- Feinman, G. M., and Carballo, D. M. (2018). Collaborative and competitive strategies in the variability and resiliency of large-scale societies in Mesoamerica. *Econ Anthropol* 5, 7–19. doi: 10.1002/sea.2.12098
- Feinman, G. M., and Neitzel, J. E. (2023). The social dynamics of settling down. *J. Anthropol. Archaeol.* 69:101468. doi: 10.1016/j.jaa.2022.101468
- Fijn, N. (2011). *Living with Herds: Human-Animal Coexistence in Mongolia*. New York: Cambridge University Press.
- Fischl, K. (2018). "Settlement layouts, systems and structure of the Otomani-Füzesabony Cultural Complex" in *Proceedings of the Settlement Layouts, Systems and Structure of the Otomani-Füzesabony Cultural Complex*. ed. K. Fischl (Miskolc: Gesta), 3–8.
- Flaherty, E. (2015). Rundale and 19th Century Irish Settlement: System, Space, and Genealogy. *Ir. Geogr.* 48, 3–38. doi: 10.55650/igi.2015.623
- Fleming, A. (1998). "The Changing Commons: The Case of Swaledale (England)" in *Prehistory in Economic Context*. eds. R. C. Hunt and A. Gilman (Lanham, MD: University Press of America), 187–214.
- Frachetti, M. D. (2012). Multiregional emergence of mobile pastoralism and nonuniform institutional complexity across Eurasia. *Curr. Anthropol.* 53, 2–38. doi: 10.1086/663692
- Frantz, L., Bradley, D. G., Larson, G., and Orlando, L. (2020). Animal domestication in the era of ancient genomics. *Nat. Rev. Genet.* 21, 449–460. doi: 10.1038/s41576-020-0225-0
- Frei, K. M., Mannering, U., Berghe, I. V., and Kristiansen, K. (2017). Bronze Age wool: provenance and dye investigations of Danish textiles. *Antiquity* 91, 640–654. doi: 10.15184/aqy.2017.64
- French, C. (2010). "The palaeo-environments of bronze age Europe" in *Organizing Bronze Age Societies: The Mediterranean, Central Europe, and Scandinavia Compared*. eds. T. K. Earle and K. Kristiansen (Cambridge: Cambridge University Press), 34–56.
- Fuks, D., Lister, D. L., Distelfeld, A., and Marom, N. (2022). A Time to Sow, a Time to Reap: Modifications to Biological and Economic Rhythms in Southwest Asian Plant and Animal Domestication. *Agronomy* 12:1368. doi: 10.3390/agronomy12061368
- Fülek, G., Kovács, G., and Vicze, M. (2015). Investigation of a Bronze Age tell using soil analysis data. *Agrokém. Talajt.* 64, 421–435. doi: 10.1556/0088.2015.64.2.9
- Fuller, D. Q., Denham, T., Kistler, L., Stevens, C., Larson, G., Bogaard, A., et al. (2022). Progress in domestication research: Explaining expanded empirical observations. *Quat. Sci. Rev.* 296:107737. doi: 10.1016/j.quascirev.2022.107737
- Gaastra, J. S., Greenfield, T. L., and Greenfield, H. J. (2020). There and back again: A zooarchaeological perspective on Early and Middle Bronze Age urbanism in the southern Levant. *PLoS One* 15:e0227255. doi: 10.1371/journal.pone.0227255
- Gál, E. (2017). "Relationships between people and animals during the Early Bronze Age in Southern Transdanubia" in *State of the Hungarian Bronze Age research*. eds. G. Kulcsár and G. Szabó (Budapest: Robinco Kft), 463–472.
- Gardiner, M., Downey, L., and Siocháin, Ó. (2020). Sustainable Rundale, Runrig, and Northern English Open-Field Historical Farming Systems: A Comparative Analysis. *Béaloideas* 88, 101–131.
- Gardner, W. R. M. (2016). *Early Political Complexity and Community Organization on the Mongolian Steppe*. New Haven, CT: Yale.
- Gävan, A. (2019). "Metalworking as a Craft in Bronze Age Europe: The Organization of Metal Production Within Tell Settlements in the Carpathian Basin" in *From Past to Present: Studies in Memory of Manfred O. Korfmann*. eds. S. W. E. Blum, T. Efe, T. L. Kienlin and E. Pernicka (Habelt, Bonn: Studia Troica Monographien), 335–358.
- Gimingham, C. H. (1993). *The lowland heathland management book*. English Nature.
- Given, M. (2020). Attending to place and time: seasonality in early modern Scotland and Cyprus. *Eur. J. Archaeol.* 23, 451–472. doi: 10.1017/ea.2020.5
- Gogálán, F. (2017). The Bronze Age Multilayered Settlements in the Carpathian Basin (ca. 2500–1600/1500 BC). An Old Catalogue and Some Chronological Problems. *J. Ancient Hist Archaeol* 4, 28–63.
- Gosden, C. (2013). "Fields" in *Counterpoint: Essays in Archaeology and Heritage Studies in Honour of Professor Kristian Kristiansen*. eds. S. Bergerbrant and S. Sabatini (Oxford: Archaeopress), 111–117.
- Graeber, D., and Wengrow, D. (2021). *The dawn of everything: A new history of humanity*. London: Penguin UK.
- Green, A. S. (2021). Killing the priest-king: Addressing egalitarianism in the Indus civilization. *J. Archaeol. Res.* 29, 153–202. doi: 10.1007/s10814-020-09147-9
- Green, A. S. (2022). Of revenue without rulers: Public goods in the egalitarian cities of the Indus civilization. *Front Polit Sci* 4:823071. doi: 10.3389/fpos.2022.823071
- Green, A., Wilkinson, T., Wilkinson, D., Highcock, N., and Leppard, T. (2024). *Cities and Citadels: An Archaeology of Inequality and Economic Growth*.
- Griffiths, S., Johnston, R., May, R., McOmish, D., Marshall, P., Last, J., et al. (2022). Dividing the land: time and land division in the English north Midlands and Yorkshire. *Eur. J. Archaeol.* 25, 216–237. doi: 10.1017/ea.2021.48
- Grimm, D. (2023). What are farm animals thinking? *Science* 382, 1103–1107. doi: 10.1126/science.adn3270
- Grossman, K., and Paulette, T. (2020). Wealth-on-the-hoof and the low-power state: Caprines as capital in early Mesopotamia. *J. Anthropol. Archaeol.* 60:101207. doi: 10.1016/j.jaa.2020.101207
- Halperin, C. T. (2017). Anthropological archaeology in 2016: cooperation and collaborations in archaeological research and practice. *Am. Anthropol.* 119, 284–297. doi: 10.1111/aman.12860
- Hammer, E. (2014). Local landscape organization of mobile pastoralists in southeastern Turkey. *J. Anthropol. Archaeol.* 35, 269–288. doi: 10.1016/j.jaa.2014.06.001
- Haruda, A. (2018). Regional pastoral practice in central and southeastern Kazakhstan in the Final Bronze Age (1300–900 BCE). *Archaeol Res Asia* 15, 146–156. doi: 10.1016/j.ara.2017.09.004
- Haughton, M., and Løvschal, M. (2023). Ancestral commons: the deep-time emergence of Bronze Age pastoral mobility. *Antiquity* 97, 1470–1487. doi: 10.15184/aqy.2023.154
- Haughton, M., and Løvschal, M. (2024). Ancestral commons theorized: the entanglement of cosmology, community and landscape use in Bronze Age Northern Europe. *J. Anthropol. Archaeol.*
- Haynie, H. J., Kavanagh, P. H., Jordan, F. M., Ember, C. R., Gray, R. D., Greenhill, S. J., et al. (2021). Pathways to social inequality. *Evolution Hum Sci* 3:e35. doi: 10.1017/ehs.2021.32
- Holland-Lulewicz, J. (2021). From categories to connections in the archaeology of eastern North America. *J. Archaeol. Res.* 29, 537–579. doi: 10.1007/s10814-020-09154-w
- Holland-Lulewicz, J., Conger, M. A., Birch, J., Kowalewski, S. A., and Jones, T. W. (2020). An institutional approach for archaeology. *J. Anthropol. Archaeol.* 58:101163. doi: 10.1016/j.jaa.2020.101163
- Holland-Lulewicz, J., Thompson, V. D., Birch, J., and Grier, C. (2022). Keystone institutions of democratic governance across Indigenous North America. *Front Polit Sci* 4:840049. doi: 10.3389/fpos.2022.840049
- Holst, M. K., and Rasmussen, M. (2012). "Combined efforts: the cooperation and coordination of barrow-building in the Bronze Age" in *Excavating the Mind: cross-sections through culture, cognition and materiality*. eds. H. J. Jensen, M. D. Jensen and N. Johannsen (Aarhus: Universitetsforlaget), 255–279.
- Holst, M. K., and Rasmussen, M. (2013). "Herder Communities: Longhouses, Cattle and Landscape Organization in the Nordic Early and Middle Bronze Age" in *Counterpoint: Essays in Archaeology and Heritage Studies in Honour of Professor Kristian Kristiansen*. eds. S. Bergerbrant and S. Sabatini (Oxford: Archaeopress), 99–110.
- Honeychurch, W. (2014). Alternative complexities: the archaeology of nomadic states. *J. Archaeol. Res.* 22, 277–326. doi: 10.1007/s10814-014-9073-9
- Honeychurch, W., Amartuvshin, C., Wright, J., Carolus, C., and Hrivnyak, M. (2023). Multiresource Pastoralism, Dynamic Foodways, and Ancient Statecraft in Mongolia. *Land* 12:1715. doi: 10.3390/land12091715
- Honeychurch, W., and Makarewicz, C. A. (2016). The archaeology of pastoral nomadism. *Ann. Rev. Anthropol.* 45, 341–359. doi: 10.1146/annurev-anthro-102215-095827
- Horne, A. E. (1873). *Alleged Destitution in Boffin and Shark Islands*. Constabulary Report. House of Commons Parliamentary Papers Online, Clifden.
- Hübner, E. (2004). Jungneolithische Gräber auf der Jütischen Halbinsel: Typologische und chronologische Studien zur Einzelgrabkultur. *Archäologisches Nachrichtenblatt* 9, 214–219.
- Ingold, T. (1993). The temporality of the landscape. *World Archaeol.* 25, 152–174. doi: 10.1080/00438243.1993.9980235
- Iversen, R. (2016). "Was there ever a single grave culture in east Denmark? Traditions and transformations in the 3rd millennium BC" in *Transitional Landscapes? The 3rd Millennium BC in Europe*. Universitätsforschungen zur Prähistorischen Archäologie. eds. M. Furholt, R. Grossmann and M. Szymt (Bonn: Dr. Rudolf Habelt), 159–170.
- Jaeger, M. (2018). "Open Communities—Enclosed Spaces. Kakucs-Turján Settlement in the Context of Local Tradition and Interregional Relations" in *Kakucs-Turján: A Middle Bronze Age Multi-Layered Fortified Settlement in Central Hungary*. Studien zur

- Archäologie in Ostmitteleuropa / Sudia nad Pradziejami Europy Środkowej. eds. M. Jaeger, G. Kulcsár, N. Taylor and R. Staniuk (Bonn: Dr Rudolf Habelt GmbH), 191–212.
- Jardat, P., and Lansade, L. (2022). Cognition and the human–animal relationship: a review of the sociocognitive skills of domestic mammals toward humans. *Anim. Cogn.* 25, 369–384. doi: 10.1007/s10071-021-01557-6
- Johannsen, N. N., Nielsen, S. K., and Jensen, S. T. (2016). “North-western Jutland at the dawn of the 3rd millennium: Navigating life and death in a new socioeconomic landscape?” in *Transitional Landscapes? the 3rd Millennium Cal Bc in Europe*. Dr. Rudolf Habelt, 35–53.
- Kanne, K. (2018). *Becoming Equestrian: People and Horses in Bronze Age Hungary*. Unpublished PhD dissertation. Evanston, IL: Northwestern University.
- Kanne, K. (2022). Riding, Ruling, and Resistance: Equestrianism and Political Authority in the Hungarian Bronze Age. *Curr. Anthropol.* 63, 289–329. doi: 10.1086/720271
- Kienlin, T. L. (2015). *Bronze Age Tell Communities in Context – An Exploration Into Culture, Society, and the Study of European Prehistory. Part 1: Critique. Europe and the Mediterranean*. Oxford: Archaeopress.
- Kienlin, T. L., Fischl, K. P., and Liviu, M. (2017). Exploring Divergent Trajectories in Bronze Age Landscapes: Tell Settlement in the Hungarian Borsod Plain and the Romanian Ier Valley. *Ziridava Stud Archaeol* 31, 93–128.
- Kinaston, R. L. (2023). “Isotopes, Domestication, and Past Animal Husbandry Practices: A Review of the Formative Studies” in *Exploring Human Behavior Through Isotope Analysis: Applications in Archaeological Research*, 155–180.
- Klehm, C., and Nyíri, B. (2016). Exploring socioeconomic relationships from surface survey ceramics: New methodologies from Bronze-Age Benta Valley, Hungary. *J. Field Archaeol.* 41, 486–499. doi: 10.1080/00934690.2016.1199197
- Knight, P. (1836). *Erris in the Irish Highlands and the Atlantic Railway*. Dublin: M. Keene.
- Kohler, T. A., Smith, M. E., Bogaard, A., Feinman, G. M., Peterson, C. E., Betzenhauser, A., et al. (2017). Greater post-Neolithic wealth disparities in Eurasia than in North America and Mesoamerica. *Nature* 551, 619–622. doi: 10.1038/nature24646
- Kovács, G., Pető, Á., and Vicze, M. (2020). Development of a Middle Bronze Age (1900–1500 cal BC) house at the site of Százhalombatta-Földvár, Hungary: detecting choice of materials by the means of archaeological thin section soil micromorphology and phytolith analysis. *Archaeol. Anthropol. Sci.* 12:258. doi: 10.1007/s12520-020-01205-z
- Kowalewski, S. A., and Birch, J. (2020). “How do people get big things done?” in *The evolution of social institutions: interdisciplinary perspectives* (New York: Springer), 29–50.
- Kowalewski, S. A., and Heredia Espinoza, V. Y. (2020). “Mesoamerica as an assemblage of institutions” in *The Evolution of Social Institutions: Interdisciplinary Perspectives* (New York: Springer), 495–522.
- Kristiansen, K. (2014). Towards a New Paradigm? The Third Science Revolution and its Possible Consequences in Archaeology. *Curr. Swed Archaeol* 22, 11–34. doi: 10.37718/CSA.2014.01
- Kristiansen, K., and Earle, T. K. (2015). “Neolithic versus Bronze Age social formations: a political economy approach” in *Paradigm found: archaeological theory present, past and future: essays in honour of Evžen Neustupný*. eds. L. Šmejda, J. Turek and E. Neustupný (Oxford: Oxbow Books), 234–247.
- Kulcsár, G., Nyíri, B., Köhler, K., Hajdu, T., Szeverényi, V., Earle, T. K., et al. (2020). Middle Bronze Age burial at the settlement of Sósút-Barátház, Site 26/4 (Central Hungary). *Antaeus* 38, 187–212.
- Laabs, J. (2023). *Wealth Consumption, Sociopolitical Organization, and Change: A Perspective from Burial Analysis on the Middle Bronze Age in the Carpathian Basin*. *Open Archaeol* 9:20220281. doi: 10.1515/oper-2022-0281
- Lash, R. (2019). *Island Taskscapes: Heritage, Ritual, and Sustainability on Inishark and Inishbofin, Ireland*. Unpublished PhD dissertation. Evanston, IL: Northwestern University.
- Lash, R. (2020). “Movement, Intersubjectivity, and Archaeology - Insights from Western Ireland” in *Routledge Handbook of Sensory Archaeology*. eds. J. Day and R. Skeates (Routledge), 130–148.
- Lash, R. (2023). “Curation and Creativity: Devotional Heritage on Inishark and Inishbofin” in *Sacred Realms and Folk Domains of Irish Holy Wells*. eds. C. Ray and F. McCormick (Indiana University Press), 264–275.
- Lash, R. (2024). *Island Endurance: Creative Heritage on Inishark and Inishbofin*. Indiana University Press.
- Le Neindre, P., Bernard, E., Boissy, A., Boivin, X., Calandrea, L., Delon, N., et al. (2017). *Animal consciousness. Summary of the multidisciplinary assessment*. Doctoral dissertation, INRA.
- Levi, M. (1988). *Of Rule and Revenue*. Berkeley, CA: University of California Press.
- Ling, J., Earle, T. K., and Kristiansen, K. (2018). Maritime mode of production: Raiding and trading in seafaring chiefdoms. *Curr. Anthropol.* 59, 488–524. doi: 10.1086/699613
- Losey, R. J., Nomokonova, T., Arzyutov, D. V., Gusev, A. V., Plekhanov, A. V., Fedorova, N. V., et al. (2021). Domestication as enslavement: harnessing reindeer in Arctic Siberia. *J. Archaeol. Method Theory* 28, 197–231. doi: 10.1007/s10816-020-09455-w
- Losey, R. J., Wishart, R. P., and Looovers, J. P. L. (2018). *Dogs in the North: stories of cooperation and co-domestication*. London: Routledge.
- Lövschal, M. (2020). The logics of enclosure: deep-time trajectories in the spread of land tenure boundaries in late prehistoric northern Europe. *J. R. Anthropol. Inst.* 26, 365–388. doi: 10.1111/1467-9655.13252
- Lövschal, M., and Damgaard, C. F. (2022). Mapping the ecological resilience of Atlantic postglacial heathlands. *J. Appl. Ecol.* 59:2825. doi: 10.1111/1365-2664.14278
- Lövschal, M., and Holst, M. K. (2014). Repeating boundaries – repertoires of landscape regulations in southern Scandinavia in the Late Bronze Age and Pre-Roman Iron Age. *Danish J Archaeol* 3, 95–118. doi: 10.1080/21662282.2014.990311
- Magyari, E. K., Chapman, J. C., Passmore, D. G., Allen, J. R., Huntley, J. P., and Huntley, B. (2010). Holocene persistence of wooded steppe in the Great Hungarian Plain. *J. Biogeogr.* 37, 915–935. doi: 10.1111/j.1365-2699.2009.02261.x
- Makarewicz, C. A. (2013). A pastoralist manifesto: breaking stereotypes and reconceptualizing pastoralism in the Near Eastern Neolithic. *Levant* 45, 159–174. doi: 10.1179/0075891413Z.00000000023
- Makarewicz, C. A., Hofmann, R., Videiko, M. Y., and Müller, J. (2022). Community negotiation and pasture partitioning at the Trypillia settlement of Maidanetske. *Antiquity* 96, 831–847. doi: 10.15184/aqy.2022.32
- Maran, T., Tønnessen, M., and Rattasepp, S. (2016). *Animal Umwelten in a Changing World: Zoosemiotic Perspectives*. Tartu: University of Tartu Press.
- Marcigny, C., and Peake, R. (2021). “My Home Is My Castle! Field Systems and Farms: Rhythm and Land Appropriation During the Bronze Age in North-West France (2300–800 BCE)” in *Europe's Early Fields: Archaeologies of Prehistoric Land Allotment Themes in Contemporary Archaeology*. eds. S. Arnoldussen, R. Johnston and M. Lövschal (Cham: Springer Nature Switzerland AG), 131–142.
- Marshall, F., and Hildebrand, E. (2002). Cattle before crops: the beginnings of food production in Africa. *J. World Prehist.* 16, 99–143. doi: 10.1023/A:1019954903395
- Marston, J. M., Çakırlar, C., Luke, C., Kováčik, P., Slim, F. G., Shin, N., et al. (2022). Agropastoral economies and land use in Bronze Age western Anatolia. *Environ. Archaeol.* 27, 539–553. doi: 10.1080/14614103.2021.1918485
- McCabe, D. (1991). *Law, Conflict and Social Order: County Mayo, 1820–1945*.
- Mlekuž, D. (2013). The Birth of the Herd. *Soc. Anim.* 21, 150–161. doi: 10.1163/15685306-12341299
- Molloy, B., Jovanović, D., Bruyère, C., Marić, M., Bulatović, J., Mertl, P., et al. (2020). A New Bronze Age Mega-fort in Southeastern Europe: Recent Archaeological Investigations at Gradište Idoš and their Regional Significance. *J. Field Archaeol.* 45, 293–314. doi: 10.1080/00934690.2020.1734899
- Molnár, Z. (2017). ‘I See the Grass through the Mouths of My Animals’ – Folk Indicators of Pasture Plants Used by Traditional Steppe Herders. *J. Ethnobiol.* 37, 522–541. doi: 10.2993/0278-0771-37.3.522
- Moritz, M. (2016). Open property regimes. *Int. J. Commons* 10:688. doi: 10.18352/ijc.719
- Murdock, G. P., and White, D. R. (1969). Standard cross-cultural sample. *Ethnology* 8, 329–369. doi: 10.2307/3772907
- Næss, M. W. (2012). Cooperative Pastoral Production: Reconceptualizing the Relationship between Pastoral Labor and Production. *Am. Anthropol.* 114, 309–321. doi: 10.1111/j.1548-1433.2012.01427.x
- Næss, M. W. (2021). Collaborative foundations of herding: The formation of cooperative groups among Tibetan pastoralists. *J. Arid Environ.* 186:104407. doi: 10.1016/j.jaridenv.2020.104407
- Nawroth, C., Langbein, J., Coulon, M., Gabor, V., Oesterwind, S., Benz-Schwarzburg, J., et al. (2019). Farm animal cognition—linking behavior, welfare and ethics. *Front. Vet. Sci.* 6:24. doi: 10.3389/fvets.2019.00024
- Nicholas, L. M., and Feinman, G. M. (2022). The foundation of Monte Albán, intensification, and growth: coactive processes and joint production. *Front. Polit. Sci.* 4:805047. doi: 10.3389/fpos.2022.805047
- Nicodemus, A. (2014). *Bronze Age Economies of the Carpathian Basin: Trade, Craft, Production, and Agro-Pastoral Intensification*. Unpublished PhD Dissertation. University of Michigan.
- Odgaard, B. V. (1994). The Holocene vegetation history of northern West Jutland. *Opera Botanica* 123, 1–171.
- Olson, M. (1965). *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.
- Ombashi, H., and Lövschal, M. (2023). Anthropogenic heathlands in prehistoric Atlantic Europe: Review and future prospects. *Eur. J. Archaeol.* 26, 341–358. doi: 10.1017/ear.2022.42
- Oosthuizen, S. (2011). Archaeology, common rights and the origins of Anglo-Saxon identity. *Early Medieval Europe* 19, 153–181. doi: 10.1111/j.1468-0254.2011.00316.x
- Oosthuizen, S. (2013). Beyond hierarchy: the archaeology of collective governance. *World Archaeol.* 45, 714–729. doi: 10.1080/00438243.2013.847634
- Oosthuizen, S. (2016a). Beyond hierarchy: archaeology, common rights and social identity. *World Archaeol.* 48, 381–394. doi: 10.1080/00438243.2016.1180261

- Oosthuizen, S. (2016b). Recognizing and moving on from a failed paradigm: The case of agricultural landscapes in Anglo-Saxon England c. AD 400–800. *J. Archaeol. Res.* 24, 179–227. doi: 10.1007/s10814-015-9088-x
- Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. New York, NY: Cambridge University Press.
- Ostrom, E. (2000). Collective action and the evolution of social norms. *J. Econ. Perspect.* 14, 137–158. doi: 10.1257/jep.14.3.137
- Ostrom, E., Gardner, R., Walker, J., Walker, J. M., and Walker, J. (1994). *Rules, Games, and Common-Pool Resources*. Ann Arbor, MI: University of Michigan Press.
- Ostrom, E., and Walker, J. (2000). “Neither Markets nor States: Linking Transformation Process in Collective Action Arenas” in *Polycentric Games and Institutions: Readings from a Workshop in Political Theory and Policy Analysis*. ed. M. D. McGinnis (Ann Arbor, MI: University of Michigan Press), 427–471.
- Outram, A. K. (2023). Horse domestication as a multi-centered, multi-stage process: Botai and the role of specialized Eneolithic horse pastoralism in the development of human-equine relationships. *Front. Environ. Archaeol.* 2, 1–15. doi: 10.3389/fearc.2023.1134068
- Outram, A., Stear, A. N., Bendrey, R., Olsen, S., Kasparov, A., Zaubert, V., et al. (2009). The Earliest Horse Harnessing and Milking. *Science* 323, 1332–1335. doi: 10.1126/science.1168594
- Parlasca, M. C., and Qaim, M. (2022). Meat Consumption and Sustainability. *Annu. Rev. Resour. Econ.* 14, 17–41. doi: 10.1146/annurev-resource-111820-032340
- Piezonka, H., Chairkina, N., Dubovtseva, E., Kosinskaya, L., Meadows, J., Schreiber, T., et al. (2023). The world's oldest-known promontory fort: Amnya and the acceleration of hunter-gatherer diversity in Siberia 8000 years ago. *Antiquity* 97, 1381–1401.
- Polányi, T. (2022). The rise of idiôtēs: Micro-politics of death and community reproduction in Bronze Age Hungary. *J. Anthropol. Archaeol.* 68:101445. doi: 10.1016/j.jaa.2022.101445
- Poroszlai, I. (2000). “Excavation campaigns at the Bronze Age tell site at Százhalombatta-Földvár I. 1989–1991; II. 1991–1993” in *SAX. Százhalombatta Archaeological Expedition. Annual Report 1 – Field Season 1998*. eds. L. Poroszlai, I. and M. Vicze (Százhalombatta, Hungary: Matrica Museum), 13–73.
- Poroszlai, I., and Vicze, M. (2000). *SAX: Százhalombatta archaeological expedition: annual report 1-field season 1998*. Százhalombatta, Hungary: Matrica Múzeum.
- Poroszlai, I., and Vicze, M. (2005). *SAX: Százhalombatta archaeological expedition: report 2—field season 2000–2003*. Százhalombatta, Hungary: Matrica Múzeum.
- Porter, A. (2012). *Mobile pastoralism and the formation of Near Eastern civilizations: Weaving together society*. Cambridge University Press.
- Portillo, M., Garcia-Suarez, A., Klimowicz, A., Barański, M. Z., and Matthews, W. (2019). Animal penning and open area activity at Neolithic Cătalhöyük, Turkey. *J. Anthropol. Archaeol.* 56:101106. doi: 10.1016/j.jaa.2019.101106
- Price, M., and Makarewicz, C. A. (2024). Wealth in Livestock, Wealth in People, and the Pre-Pottery Neolithic of Jordan. *Camb. Archaeol. J.* 34, 65–82. doi: 10.1017/S0959774323000136
- Quinn, C., and Ciugudean, H. (2018). Settlement placement and socio-economic priorities: Dynamic landscapes in Bronze Age Transylvania. *J. Archaeol. Sci. Rep.* 19, 936–948.
- Randall, C. (2021). “A Sheep's Eye View: Land Division, Livestock and People in Later Prehistoric Somerset, UK” in *Europe's Early Landscapes: Archaeologies of Prehistoric Land Allotment, Themes in Contemporary Archaeology*. eds. S. Arnoldussen, R. Johnston and M. Lovschal (Springer Nature Switzerland AG: Cham), 53–70.
- Reinhold, S., Eger, J., Benecke, N., Knipper, C., Mariaschk, D., Hansen, S., et al. (2023). At the onset of settled pastoralism – Implications of archaeozoological and isotope analyses from Bronze age sites in the North Caucasus. *Quat. Int.* doi: 10.1016/j.quaint.2023.05.008
- Ritchie, H., Rosado, P., and Roser, M. (2019). *Meat and Dairy Production*. Available at: <https://ourworldindata.org/meat-production>
- Röpke, A. (2021). “In the Swamp – First Palynological Results for the Bronze Age Tell Otomani-Cetate de pământ (Romania)” in *Bronze Age Tell Settlements in North-Western Romania: Current Approaches and Recent Investigations*. eds. T. L. Kienlin and A. Găvan (Bonn: Verlag Dr. Rudolf Habelt GmbH), 241–252.
- Rouse, L. M., Dupuy, P. N. D., and Brite, E. B. (2022). The Agro-pastoralism debate in Central Eurasia: Arguments in favor of a nuanced perspective on socio-economy in archaeological context. *J. Anthropol. Archaeol.* 67:101438. doi: 10.1016/j.jaa.2022.101438
- Sabatini, S., Bergerbrant, S., Brandt, L. Ö., Margaryan, A., and Allentoft, M. E. (2019). Approaching sheep herds origins and the emergence of the wool economy in continental Europe during the Bronze Age. *Archaeol. Anthropol. Sci.* 11, 4909–4925. doi: 10.1007/s12520-019-00856-x
- Salzman, P. C. (2002). Pastoral nomads: some general observations based on research in Iran. *J. Anthropol. Res.* 58, 245–264. doi: 10.1086/jar.58.2.3631038
- Scarsbrook, L., Frantz, L., and Larson, G. (2024). “Unwrapping the palimpsest of animal domestication through ancient nuclear genomes” in *Reference Module in Earth Systems and Environmental Sciences*.
- Sharifian, A., Gantuya, B., Wario, H. T., Kotowski, M. A., Barani, H., Manzano, P., et al. (2023). Global principles in local traditional knowledge: A review of forage plant-livestock-herder interactions. *J. Environ. Manage.* 328:116966. doi: 10.1016/j.jenvman.2022.116966
- Shipman, P. (2010). The Animal Connection and Human Evolution. *Curr. Anthropol.* 51, 519–538. doi: 10.1086/653816
- Skals, I. (2020). “To let textiles talk: fibre identification and technological analyses of prehistoric textiles from Denmark” in *The Textile Revolution in Bronze Age Europe*. eds. S. Sabatini and S. Bergerbrant (Cambridge: Cambridge University Press), 134–153.
- Slater, E., and Flaherty, E. (2009). Marx on primitive Communism: the Irish rundale agrarian commune, its internal dynamics and the metabolic rift. *Irish J. Anthropol.* 12, 5–26.
- Sørensen, M. L. S. (1997). Reading dress: the construction of social categories and identities in Bronze Age Europe. *J. Eur. Archaeol.* 5, 93–114. doi: 10.1179/096576997800703656
- Sørensen, M. L. S. (2010). “Households” in *Organising Bronze Age Societies. European Society in Late Prehistory: A Comparative Approach*. eds. T. K. Earle and K. Kristiansen (New York: Cambridge University Press), 122–154.
- Sørensen, M. L. S., Vicze, M., and Sofaer, J. (2020). “Animal remains and the Bronze Age tell settlement at Százhalombatta-Földvár in Hungary Százhalombatta Archaeological eXpedition (Százhalombatta, Hungary: Matrica Museum), 11–18.
- Stépanoff, C., and Vigne, J. D. (2018). *Hybrid Communities: Biosocial Approaches to Domestication and Other Trans-species Relationships*. Oxford: Routledge.
- Stephens, L., Fuller, D., Boivin, N., Rick, T., Gauthier, N., Kay, A., et al. (2019). Archaeological assessment reveals Earth's early transformation through land use. *Science* 365, 897–902. doi: 10.1126/science.aax1192
- Stevens, C. J., and Fuller, D. Q. (2012). Did Neolithic farming fail? The case for a Bronze Age agricultural revolution in the British Isles. *Antiquity* 86, 707–722. doi: 10.1017/S0003598X00047864
- Stobbe, A., Gumnior, M., Rühl, L., and Schneider, H. (2016). Bronze Age human-landscape interactions in the southern Transural steppe, Russia—Evidence from high-resolution palaeobotanical studies. *Holocene* 26, 1692–1710. doi: 10.1177/0959683616641740
- Szevérenyi, V., Czukor, P., Priskin, A., and Szalontai, C. (2017). “Recent work on Late Bronze Age fortified settlements in south-east Hungary” in *Fortifications: The Rise and Fall Of Defended Sites In Late Bronze And Early Iron Age Of South-East Europe*. eds. B. Heeb, A. Szentmiklosi, R. Krause and M. Wemhoff (Berlin: Staatliche Museen zu Berlin), 135–148.
- Szevérenyi, V., and Kulcsár, G. (2012). “Middle Bronze Age Settlement and Society in Central Hungary” in *Open Society. Contact and Exchange in the Context of Bronze Age Fortified Settlements in Central Europe*. eds. M. Jaeger, J. Czebreszuk and K. Fischl, and SAO/SPES (Poznań-Bonn: Habelt), 287–351.
- Thomas, M. G., Bårdsen, B.-J., and Næss, M. W. (2018). The narrow gap between norms and cooperative behavior in a reindeer herding community. *R. Soc. Open Sci.* 5, 1–10. doi: 10.1098/rsos.171221
- Thompson, V. D. (2023a). Considering Urbanism at Mound Key (Caalus), the capital of the Calusa in the 16th Century, Southwest Florida, USA. *J. Anthropol. Archaeol.* 72:101546. doi: 10.1016/j.jaa.2023.101546
- Thompson, V. D. (2023b). Considering ideas of collective action, institutions, and “hunter-gatherers” in the American Southeast. *J. Archaeol. Res.* 31, 503–560. doi: 10.1007/s10814-022-09179-3
- Vandkilde, H. (2016). *Bronzization: The Bronze Age as Pre-Modern Globalization*. *Præhistorische Zeitschrift* 91, 103–123. doi: 10.1515/pz-2016-0005
- Ventresca Miller, A. R., Bragina, T., Abil, Y., Rulyova, M., and Makarewicz, C. (2019). Pasture usage by ancient pastoralists in the northern Kazakh steppe informed by carbon and nitrogen isoscapes of contemporary floral biomes. *Archaeol. Anthropol. Sci.* 11, 2151–2166. doi: 10.1007/s12520-018-0660-4
- Ventresca Miller, A. R., Haruda, A., Varfolomeev, V., Goryachev, A., and Makarewicz, C. (2020). Close management of sheep in ancient Central Asia: evidence for foddering, transhumance, and extended lambing seasons during the Bronze and Iron Ages. *Sci. Technol. Archaeol. Res.* 6, 41–60. doi: 10.1080/20548923.2020.1759316
- Ventresca Miller, A. R., Wilkin, S., Hendy, J., Turbat, T., Batsukh, D., Bayarkhuu, N., et al. (2022). The spread of herds and horses into the Altai: How livestock and dairying drove social complexity in Mongolia. *PLoS One* 17:e0265775. doi: 10.1371/journal.pone.0265775
- Vera, F. W. M. (2000). *Grazing ecology and forest history*: CABI publishing.
- Vicze, M., Sofaer, J., and Sørensen, M. (2014). Glimpsing social organisation—evidence from the Bronze Age tell at Százhalombatta-Földvár. *Hungar. Archaeol. E-Journal*, 1–4.
- Vretemark, M. (2010). “Subsistence strategies” in *Organizing Bronze Age Societies: The Mediterranean, Central Europe, and Scandinavia Compared*. eds. T. K. Earle and K. Kristiansen, 155–184.
- Vretemark, M., and Sten, S. (2020). Animal bones from the Bronze Age tell settlement of Százhalombatta-Földvár in Hungary. Százhalombatta, Hungary: Matrica Museum.
- Whelan, K. (1994). “Settlement patterns in the west of Ireland in the pre-Famine period” in *Decoding the landscape*. ed. T. P. Collins, Galway: Centre for Landscape Studies, University College Galway. 60–78.
- White, T., and Fijn, N. (2020). Multispecies Co-existence in Inner Asia: Introduction: Resituating Domestication in Inner Asia. *Inner Asia* 22, 162–182. doi: 10.1163/22105018-12340145
- Yager, T. (2002). What was Rundale and where did it come from? *Béaloideas* 70, 153–186. doi: 10.2307/20520797
- Zeder, M. (2015). Core Questions in Domestication Research. *Proc. Natl. Acad. Sci.* 112, 3191–3198. doi: 10.1073/pnas.1501711112
- Zeder, M. (2016). Domestication as a model system for niche construction theory. *Evol. Ecol.* 30, 325–348. doi: 10.1007/s10682-015-9801-8
- Zeder, M. A., and Lemoine, X. (2023). A journey begins with a single step: how early Holocene humans and wild boar (*Sus scrofa*) embarked on the pathway to domestication in the eastern fertile crescent. *J. Archaeol. Method Theory* 30, 895–963. doi: 10.1007/s10816-022-09576-4



OPEN ACCESS

EDITED BY

Victor D. Thompson,
University of Georgia, United States

REVIEWED BY

Katherine Kanne,
University College Dublin, Ireland
Lorenzo Zamboni,
University of Milan, Italy

*CORRESPONDENCE

Simon Stoddart

✉ ss16@cam.ac.uk

Laura Motta

✉ lmotta@umich.edu

RECEIVED 02 February 2025

ACCEPTED 19 May 2025

PUBLISHED 30 July 2025

CITATION

Stoddart S, Breslin EM, Esposito C, Gavériaux F, Marras G, McLaughlin R, Motta L, Prato O, Schmidt F and Zeviani C (2025) The process of nucleation amongst the early cities of central Italy in the first millennium BC. *Front. Hum. Dyn.* 7:1569997. doi: 10.3389/fhumd.2025.1569997

COPYRIGHT

© 2025 Stoddart, Breslin, Esposito, Gavériaux, Marras, McLaughlin, Motta, Prato, Schmidt and Zeviani. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

The process of nucleation amongst the early cities of central Italy in the first millennium BC

Simon Stoddart^{1*}, Emily M. Breslin², Carmen Esposito³, Fanny Gavériaux⁴, Gianbattista Marras¹, Rowan McLaughlin⁵, Laura Motta^{6*}, Ornella Prato⁷, Frijda Schmidt¹ and Camilla Zeviani¹

¹University of Cambridge, Cambridge, United Kingdom, ²Trinity College Dublin, Dublin, Ireland,

³Department of Cultural Heritage, University of Bologna, Ravenna, Italy, ⁴Department of Archaeology, Cambridge, United Kingdom, ⁵Hamilton Institute, Maynooth University, Maynooth, Co. Kildare, Ireland, ⁶Department of Classical Studies, University of Michigan, Ann Arbor, MI, United States,

⁷Institute of Archaeology, University College London, London, United Kingdom

This article assesses the process of nucleation amongst the early cities of Tyrrhenian central Italy in the first millennium BC. The article examines the advantages, disadvantages and causes of nucleation. A multi-proxy and multi scalar perspective is implemented drawing on the available evidence for ancient DNA, isotopes, pedology/geoarchaeology, animal and plant remains, contextualized within the settlement archaeology. The article contains original data for settlement distribution, plant remains and stable isotopic analysis of plants.

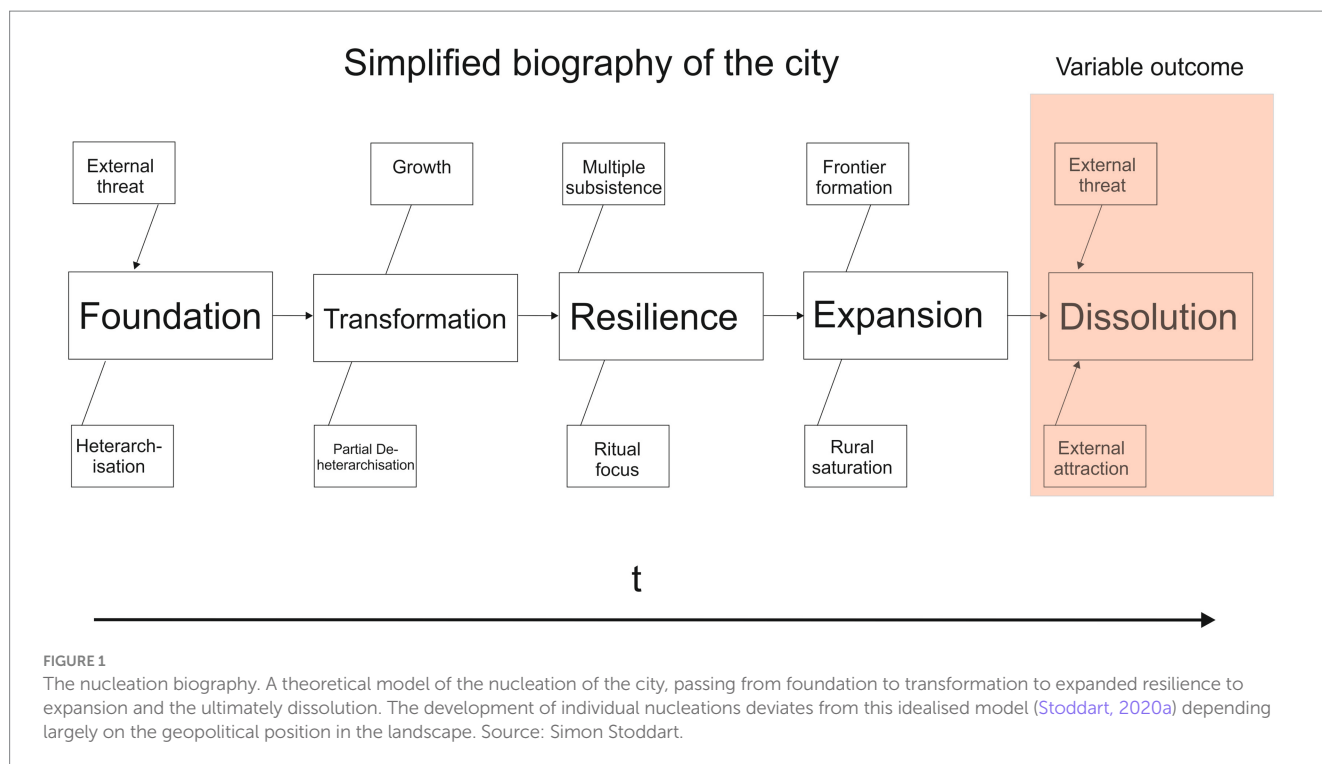
KEYWORDS

nucleation, central Italy, ancient DNA, isotopes, first millennium BC, Etruria, plant agriculture, animal husbandry

1 Introduction

People make places nucleated (cf. [Fox and Wolf, 2024](#)). Nucleation, defined simply as the aggregation of substantial numbers of individuals in one relatively closely defined place on a long-term basis, has biography ([Figure 1](#)). It goes through a series of stages, passing from the vulnerable stage of experimental foundation to subsequent stages of transformation, resilience, potentially expansion and ultimately dissolution, sometimes after a considerable period. This is not a unilineal model, since such development can comprise substantial variation ([Stoddart, 2020a; Zeviani 2023](#)), indeed this is a characteristic of our case study. The model allows us to measure the variability of these changes through the understanding of the development of settlement, coupled with evidence for subsistence (by modelling food records onto the landscape) and political processes from the study of the internal trajectories of cities and their impact on their territory. In certain circumstances, we can identify the institutions that sustained these changes, and their transformation through time. We can now begin to add the missing element of the agency and dynamism of the actual people increasing in number and moving through the landscape by means of the evidence of a combination of ancient DNA (aDNA) and stable and radiogenic isotopes at the foundational, transformative and resilient stages.

Recent work has examined the underlying causes of stability and delicacy/fragility of urban societies ([Stoddart, 2017a; Yoffee, 2019](#)). These results show the tension between social resilience/fragmentation and the underlying biological and ecological forces that control demography and sustain/weaken the new nucleated experiments, which led to urbanism when they endured. The resilience of the original nucleation depended on the durability of the



collective social action that brought smaller communities together. For this purpose, the human landscape needs to be modelled, enhanced by the insertion of rural settlement and ground-truthed by the re-examination of original survey data (Stoddart, 2017b; Zeviani, 2023). In tandem, we can seek to investigate mobility, diversity and the range of the city in controlling the mobility of humans and animals, over the course of time. Humans tend to accompany and guard their flocks and thus register their range of territorial access. In this way, we can test the social model of urbanism by examining the ebb and flow of individuals to and from the center.

Work on the nucleation in central Italy in the first millennium BC has focused on institutions inferred from cultural achievements, notably the built environment, rich material culture and ritual, especially burial. These approaches are the intellectual heritage of concentrated expertise over many centuries of archeological research. While summarizing some of this long-standing research, which is too extensive to cover here in anything like its entirety, this article primarily takes a complementary and integrative approach that examines the tempo and sequence of nucleation and accompanying institutions alongside its supportive infrastructure in central Italy during the first millennium BC. For this purpose, we focus on the available data on the biological side of the city (aDNA, isotopes, animal remains and the physical environment) and how these interface with the built environment.

Recent anthropological scholarship (summarized in Holland-Lulewicz et al., 2020) and applied to urbanism (Thompson, 2023)) has stressed the importance of institutions that structured nucleated society. Tantalizing textual accounts of the Etruscans point to leaders, often identified as Kings in a number of the urban communities (Tagliamonte, 2017). A major moment of transition is indicated within the sequence of Tarquinia at the early seventh century BC level where symbols of authority, the trumpet, axe and shield, were found, but these do not by themselves indicate the

nature of the institutional authority behind them. From the fourth century BC onwards, the term *zilath* (usually translated as magistrate) appeared, indicating figures of accepted institutional authority. This term seems to be part of a spatially nested and overlapping set of terms, community (*spura*), city (*methlum*), village (*tuthina*), citadel (*cilth*) and people (*rasna*).

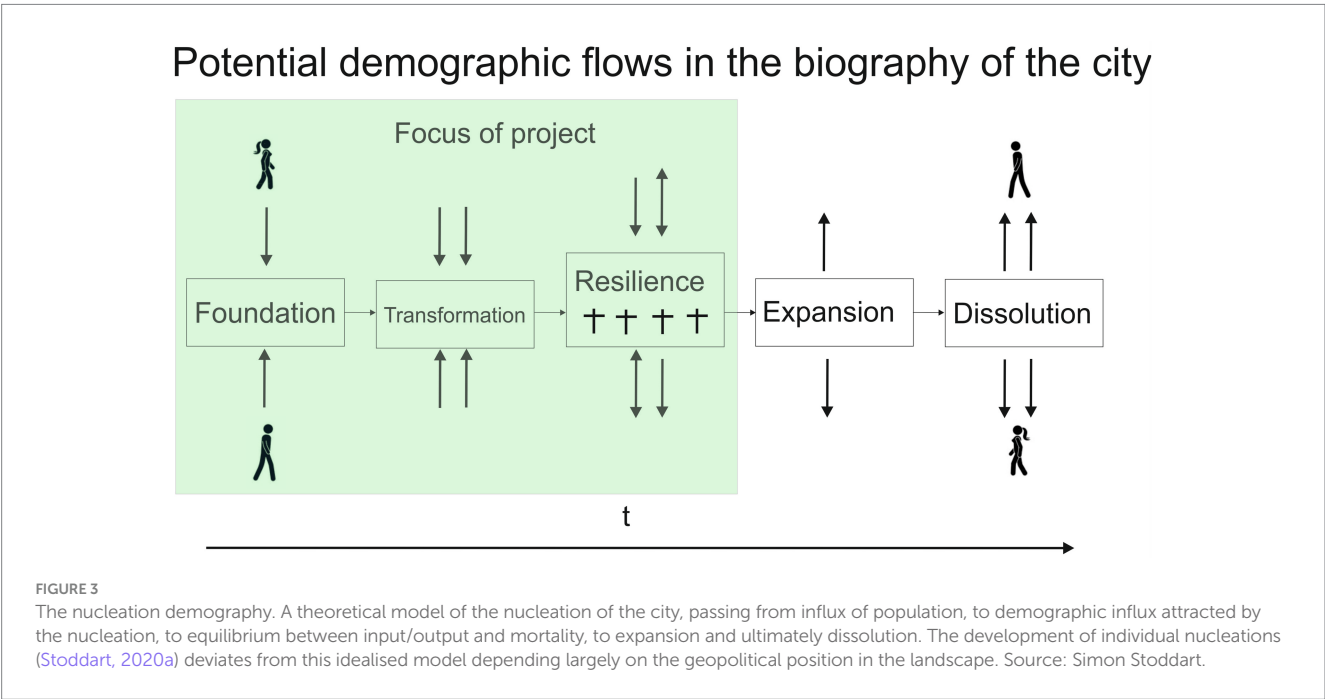
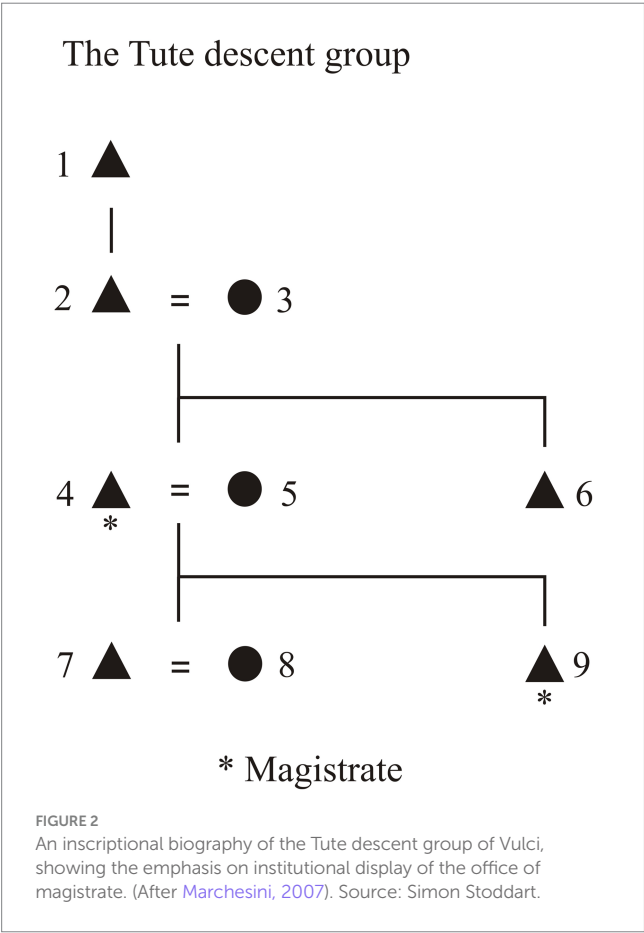
The Etruscan evidence from cemeteries and settlements suggests that durable descent groups provided the main institutional focus, which, over time, were encased but never superseded by overarching ritual and incipient political institutions, made visible by offices such as the magistracies. These ritual institutions provided long-term, specialized knowledge, and from the evidence of inscriptional display in later tombs (Figure 2), the tenure of magistracies offered considerable prestige. This perspective is also supported by the *elogia* of Tarquinia where such personal histories are celebrated (Cornell, 1976, pp. 425–426).

The resilience (primarily measured in terms of duration; Smith et al., 2021) of the city has its own biography. There is a process of foundation, often considered, in the case of our example of Etruria, to be caused by a context of political uncertainty, by a requirement of defense, headed by a military elite, even though this elite is not easily visible in the archeological record. There was subsequently a maintenance of the city's attractive qualities by means of collective ritual, by the pooling of resources to create a built environment and a reservoir of expertise, most notably visible archeologically in the production of material culture, which attracted an ever-larger community and maintained the demographic profile through cultural and social resilience. These processes have been deeply studied by the cultural engineers of the ancient world. Similarly, surface survey has also now demonstrated the transition from village to nucleated life, giving one dimension of the probable mobility of descent groups into the metropole (as defined in Kopytoff, 1989), an increasingly popular destination that created a resilience embedded in numbers.

New dimensions of resilience are, moreover, currently emerging through the application of archeological science, particularly life sciences: namely population growth accompanied by high levels of mobility and diversity of the communities' inhabitants recovered from their very bodies rather than inferred from their settlements or the

richness of their material culture. The body, therefore, becomes as central as material culture to interpret past population dynamics (Blake, 2025). Sample sizes are still low, but they are beginning to converge on meaningful patterns (e.g., Scheeres et al., 2013; Trentacoste et al., 2020; Esposito et al., 2023; Bagnasco et al., 2024; Ricconi et al., 2024). Furthermore, we can now model the potential agricultural support in the landscape by assessing soils against the distribution of urban centers and rural settlement, with the advent of relatively big data models and modelling (Zeviani, 2023; Zeviani et al., 2025; Zeviani, 2025). Whilst the metropole was attractive, it still depended on its countryside to survive, and, to understand that survival, we need to model its foundations. Finally, new studies of human remains have registered a presence of selective violence, most probably implemented only when other modes of resilience failed. Simultaneously, the human body has been shown to be a receptacle of stress and disease. This reminds us that the process of nucleation was not entirely a pacific and gentle process, but one accompanied by severe stresses of interpersonal disagreement and conflict and difficult health developments during the life course.

The result is a fuller biography (Figure 3) of nucleation and accompanying institutions from the time of foundation through periods of maintenance, including acts of repression, as well as expansion. We can begin to understand the underlying social processes, employing the powerful African model of Kopytoff, as applied by Stoddart (2020a) and Zeviani (2023) for Etruria, who ultimately established that cities (metropolises) live or die by the application of political manipulation of descent groups. Under this social model and demographic availability, the adventurous and the deviant seek to move from their home metropole and set up new nucleations which sometimes succeed and sometimes fail. A successful nucleation has not only to attract new members, maintaining population levels sometimes competing with a high death rate, but also compete with other nucleated communities for its members. We can see this phenomenon during the full Etruscan period, when the main Etruscan cities ultimately won the competition against



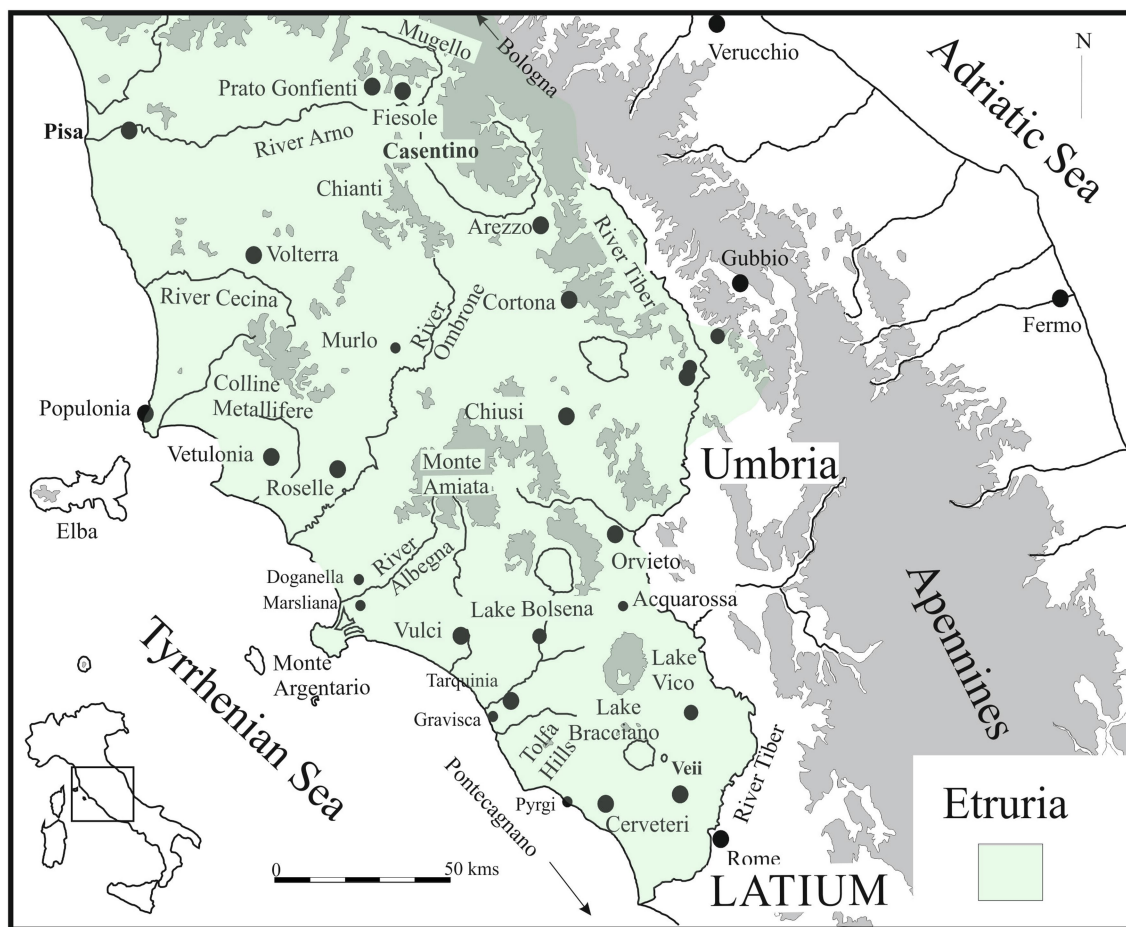


FIGURE 4
Map of Etruria, showing major sites. Source: Simon Stoddart.

nascent nucleations on their peripheries, be they centers of broadly Etruscan identity or those in more dispersed mountainous areas attributed to other cultural entities such as the Umbrians. Moreover, the Latins (transformed into Romans) later persuaded many of these same Etruscan communities to transfer their allegiance, not only by the famous Roman coercion, but also by offering a “better” political and cultural deal to their central institutions, leading to a relatively rapid transition from one locus of nucleation to another. We can thus conclude that social resilience is as important as ecological resilience in the maintenance of these highly successful communities.

In the context of Etruria (Figure 4), we are dealing with a nesting of the micro (implemented in historical times by Ginzburg, 1993) within the macro, the classical detail within the wide-ranging sample of archeological science, with agency as a part of the process. One approach is to build up a set of microhistories, even if these can be profoundly influenced by pre-suppositions of cultural context, ultimately drawn from ancient authors (Bagnasco et al., 2024). Others are based on a combination of archeological science and carefully constructed cultural information without the impact of peri-textual sources (Esposito et al., 2023). It is vital to situate these microhistories within a broader macro context, including rates of general population growth, and that is the approach taken here. In many ways, this is no different from the varied schools of landscape archeology (Stoddart,

2000), stretching from David Clarke (1972) to Chris Tilley (1994) and into the current millennium (DeMarrais and Earle, 2017, pp. 195–196), or settlement archeology as expressed many years ago by Flannery (1976), where nested scales of analysis are critical to understanding how society, and, in this particular instance, nucleation operated. It is also an expression of current understandings of globalization where the local should also be articulated with the global (Stoddart, 2022a). It is no accident that nucleation in the central Mediterranean took place at the same time as processes of globalization. One needs to be nested within the other to have a full and comprehensive effect.

International scholars have been generally aware of what the classical world can offer archeology by way of rich examples (cf. Flannery and Marcus, 1983) for a broader intellectual understanding and how that world has influenced our understanding of other worlds in spite of their differences (MacCormack, 2007). However, if one examines comparative examples of archeology, it is notable, dare we say notorious, that the study of one of the major European urban civilizations, namely the Etruscans, has largely escaped the gaze of anthropological archeology. This is not for want of instructive data. It is for want of exposure of the substantial data to a world outside broadly classical archeology, whereas the *giant* civilizations of classical archeology, Greece and Rome, because of their varied legacies

(cultural and political) to the Western world have been examined with much greater thoroughness. One new contribution from archeological science in Etruria is that we now have the data to begin to understand demography and the movement of individuals through these scales, and Etruria is now beginning to yield this cutting-edge evidence. This will enable a proper comparative flavor to the research.

2 Theoretical approaches

2.1 Robust and delicate nucleation

Nucleation provides both advantages and challenges. The advantages of collective action (Blanton and Fargher, 2008; DeMarrais, 2016; DeMarrais and Earle, 2017) are well defined. We can identify as especially cogent the factors that depend on weight in numbers: collective identity, differentiated responsibilities (including roles for ambitious individuals) and pooled resources. The subsequent challenges for the nucleated community, and its long-term resilience, rest on how to provide the resources to support and maintain such large numbers and how to prevent social dissension and disease. New data are beginning to assess the central issue of quantifying the level of flow of people into and out of the city from an integrated social anthropological and biological perspective.

In some cases, the political endeavor of nucleation was successful and enduring. Collective identity was supported by ideology and religion, often manifested securely by shared burial customs and ritual authority. Numbers counted in securing the collective against opposing forces. Responsibilities, including power, were successfully differentiated. Resources were carefully balanced both within the city itself and necessarily from the surrounding countryside. In other cases, the endeavor was faltering and ultimately short-lived. This may have been because of a lack of collective identity, or a failed ability to pass on the sense of collective identity between generations. Furthermore, collective identity may have been vested at a micro-level, namely the descent group and thus have provided an alternative focus of solidarity (Helms, 2007) to the nucleated community. Numbers may ultimately have proved to be insufficient, particularly in competition with other nucleated centers. Responsibilities may have been ineffectively distributed such as to create conditions of dissension. Resources may have been difficult to procure satisfactorily, particularly if factors of ecological resilience were not built into the equation. Resilience is measured by solving these issues.

In the European theatre of nucleation in the first millennium BC, there was an apparent account of two contrasting trends, broadly placed north and south of the Alps. In this reading, south of the Alps, there were numerous examples of apparently stable “eternal” nucleation. The Latins and the Greeks, epitomized by Rome and Athens, had long materialized sequences, apparently without interruption. Textual sources inform on some elements of dissension, but the built environment shows continuity. North of the Alps, prior to Roman political incorporation of some of the same landscapes, the contrasting pattern is that nucleation appears to have been difficult to maintain over more than a few generations (Stoddart, 2017a). Nucleation reverted to dispersal. Etruria drew on both these trends. Metropolises (the term coined by Kopytoff) provided a focus of continuity, that is successful resilience. However, at the frontiers between these great centers, there were much shorter-lived nucleations

that were ultimately not tolerated by the great metropolises themselves (Stoddart, 2000; Zeviani, 2023), showing insufficient resilience in terms of population numbers, social institutions and resources to resist more powerful neighbors. In this way, Etruria offers many empirical data for the study of nucleation that many other European examples did not achieve. It offers an understanding of how robust and delicate nucleation can co-exist. On the one hand, force of numbers, accompanied by ecological and political resilience prevailed, that is, until a more effective political force, that of the Romans replaced the Etruscan equilibrium. On the other hand, in the interstices, smaller population numbers confined in space were unable to develop the resilience faced by larger surrounding metropolises.

2.2 The experiment of nucleation

As projected by Henry Wright (2006), nucleation (for him state formation) was an experimentation taking place between closely spaced intensely competing centers, showing signs of conflict. Nucleation was also an experiment in Europe at this time. Other instances of nucleation had taken place millennia earlier, notably in what is now the Ukraine (Chapman et al., 2014), and in the second millennium in the Aegean (Parkinson and Galaty, 2007), but for the most part nucleation was a new way of living which required new ecological, material and social technologies to achieve success. Central Italy engaged in that experimentation in broadly the same way as envisaged by Henry Wright in Madagascar. Many of the Etruscan centers were closely spaced (Stoddart, 2020a) and there is emerging evidence of conflict (Bagnasco et al., 2024). However, whereas some regions maintained nucleation, others failed to sustain this process in the competitive arena in which they existed, and still others chose strategies which continued to avoid nucleation, most notably in the more remote valleys and mountainous areas surrounding Etruria and Latium, denominated by the written sources as Sanniti and Vestini. These communities had a different form of resilience that was often born out of independence of action founded on mobility and proximity to resources which may have been differently shared in a more dispersed human landscape. Nucleation was not the only strategy, and populations in the age of experimentation would have had memories of these alternatives.

2.3 Concepts of resilience

The robustness of nucleation requires a social technology to replace these potentially attractive memories both to overcome the advantages of dispersal and to enhance the advantages of concentrated resources. Understanding the social city is fundamental, since it is closely related to strategies of social resilience by the formation of enduring institutions. Boissevain (1964, 1979, 2011, 2013) drawing ultimately on his studies of the intimate interactions in the small scale nucleations of village life in Malta, by implication points to the difficulties of maintaining cohesion as nucleation increases in size. The solution in small scale Malta was to maintain a heterarchical structure of competing smaller scale elements. This can be a successful strategy, provided these heterarchical elements are not tempted to move toward other allegiances, based on kin or other forms of association. Success is tempered by vulnerability, especially to external forces. Kopytoff

(1989) and Terrenato (2019) in their substantially different ethnohistorical contexts, Africa and early Rome, point to the need for an enduring attraction of nucleation to avoid fission. Dismantling of the component parts (aka descent groups) of nucleated centers may often have been particularly to the advantage of other nucleated centers, both incipient and already formed, which may have appeared to offer more to descent groups who found themselves at odds with any emerging dominant authority. Kopytoff (1989) envisaged a meteorological power map in the African continent, of highs and lows, where there was always the temptation to move toward the political low of the internal frontier where opportunity beckoned, but to move back if this solution was unsustainable. Terrenato (2019), more recently in the context of Roman central Italy employing ethnohistorical data, has envisaged a competitive political landscape where descent groups were the main power brokers, seeking to recruit to their own nucleated centers. This would ultimately reduce the need for military action by external polities such as Rome, since employing modes of political persuasion is much more effective than the heavy weight of coercion.

The resilience of a given nucleation can be shown to be related to the form of socio-political strategy deployed to maintain cohesion, and that a collective strategy was generally more enduring (Feinman and Carballo, 2018). Many nucleations had a tension between the institutional coherence of the whole community and the social networks that constituted that community (Min, 2019). The ability of the social networks to mitigate these tensions led to the overall resilience of the nucleation. The Etruscan case had a particular fit within this scenario, since the material remains and more particularly their historiographical analysis seem to suggest great dependence on long distance trade, great disparities of wealth at least displayed in death, and a great emphasis on exclusive monumental architecture once again most visible in death, all categories suggested to be part of a less collective strategy (Feinman and Carballo, 2018, Table 1). An important fact of mitigation of the tensions is that these resources were distributed heterarchically along lines of descent groups and less centrally, thus potentially promoting an alternative equilibrated stability, a form of intra-community peer polity interaction. At a scalar level we can see this in fractal terms. The peer polity interaction of descent groups within the communities mirrored the peer polity interaction of communities within the Etruscan human landscape. This heterarchical pattern may had an intimate component, closely related to the modern concept of the 15 min and the Third Place. In these smaller quarters of the city, the heterarchical elements of the city could have maintained their cohesion. Unfortunately, only a few Etruscan cities, such as the late Etruscan city of Marzabotto (Figure 5), have had sufficient open area excavation undertaken to examine the material evidence of this interpretation. The combination of stabilizing heterarchy focused on ancestral descent groups and strong international trade appears to have a broad similarity with the nucleations of the Swahili of East Africa which endured for many hundreds of years (Robertshaw, 2019, p. 152). We further suggest that this emphasis on the material form has to be complemented by study of the human (including direct biological) evidence to achieve a more complete picture of the balance of social power, most notably in the interpretation of diet, mobility and kinship from isotopes and the relationship to the rural territory and the frontier.

Archeology can add an extra dimension to this ethnohistoric view from the nucleated center. Social resilience also relates to how the

nucleation relates to its hinterland. This is partly a demographic equation, namely where people are located, but logically extends to a relationship of identity and administration over territory, and the degree to which a recognizable frontier forms to the territory of the neighboring nucleation. The structure of the countryside also gives a measure of the varied flexible strategies that might be adopted to support nucleation, and the Etruscan case, in common with the Harappan case (so different in other ways) (Petrie, 2019), gives many examples of this in practice.

The Etruscan case study thus gives many opportunities to explore multiple dimensions and practices of nucleation that can then be integrated into one variegated account, drawing on both cultural achievements and scientific data. A city was hungry for people and consequently food, and thus its ecology was critical to provide sufficient support. A city was potentially very diverse, since the local area was unlikely to provide the full required demographic profile. When consensus and the collective failed, the city also had the potential for violence. The sheer numbers of individuals may also have created conditions of reduced health, the so-called graveyard effect. Decline in stature, a possible indicator of health, amongst related populations (Sparacello et al., 2017) is a pattern confirmed by Parkinson et al. (2023) on the basis of a larger, but still less powerful, sample for the Iron Age. Ritual was a prominent feature and does seem to have provided a counterweight to tendencies to fragment. In this way, a balanced perspective of Etruscan nucleation can be achieved.

3 Biography. The tempo and sequence of nucleation in central Italy during the first millennium BC

3.1 Foundation

There is much discussion about the process of Etruscan nucleation which has been covered elsewhere (Stoddart, 2022b). Curiously the term nucleation is not favored, but the discussion is couched in terms of changing cultural entities such as a transition from proto-urban to urban. Early accounts have suggested a Norman model for Etruscan society where a small immigrant military class subjugated an indigenous peasantry (Ward-Perkins, 1959, p. 15). More recent research has criticized this approach (Amann, 2024), since both settlement evidence and a reading of the incoming biological evidence suggest a substantially local development. We can, nevertheless detect that the key traditional scholarly debates of Etruscan urbanism are about the degree of influence from more “culturally advanced” (terminology used by the practitioners but not shared by the present authors) civilizations such as the Greeks (Pallottino, 1975), the degree to which key figures drove the nucleation (Torelli, 1981), and whether these key figures were part of a male military elite (di Gennaro, 2000; Pacciarelli, 2000). In previous work, one of us has compared this debate to the situation in the Valley of Oaxaca (Stoddart, 2010, 2020a). In other words, this is a debate between individual and collective action. It is a debate that permeates the discussion of modern historians in periods much closer to our own, with direct effects on our current and personal lives (Garton Ash, 2023). In reality, the scales of individual agency and collective authority may have ultimately worked together, as illustrated clearly in the modern world.

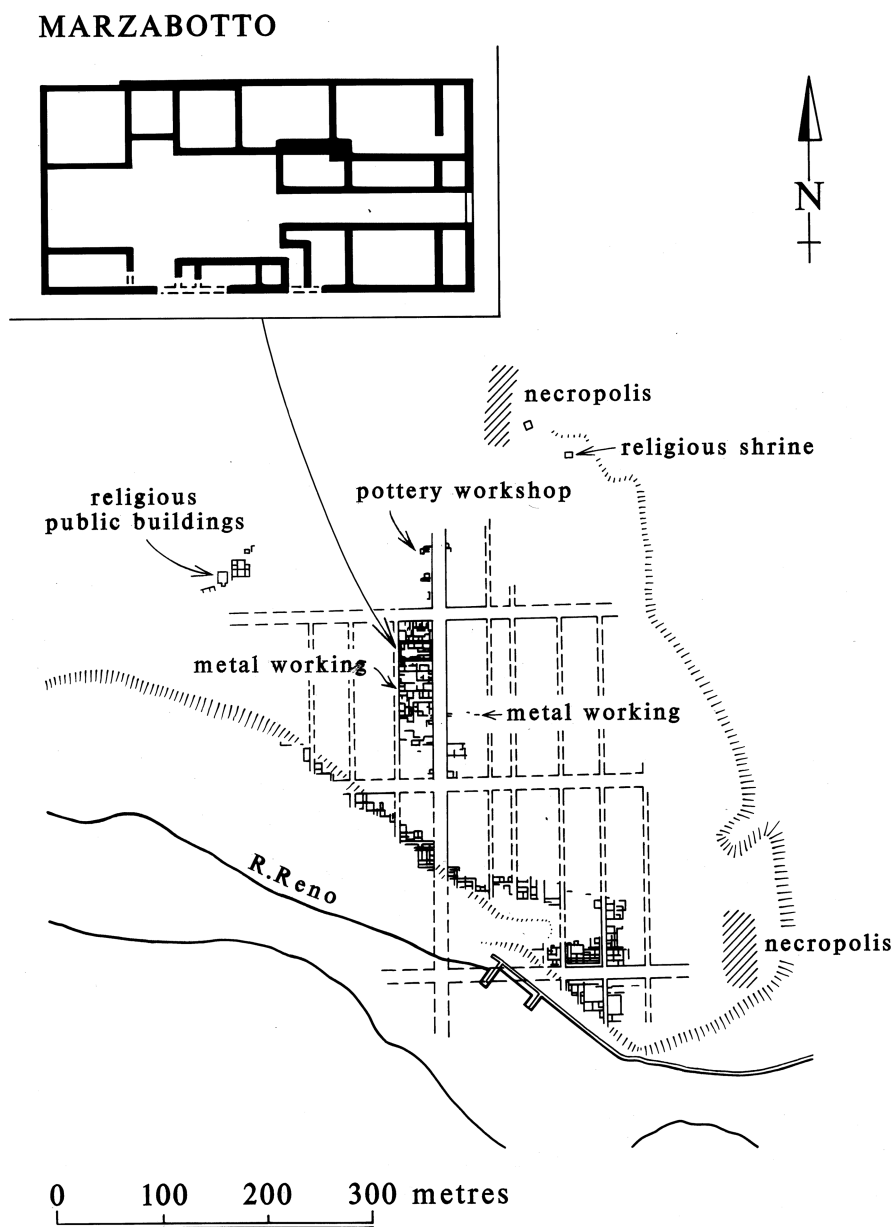


FIGURE 5
Plan of Marzabotto. Source: Simon Stoddart.

Recent work in Etruria has shown the transition from villages to plateau had an intermediate stage where clusters of smaller villages gathered around larger villages before the definitive transfer to the larger plateau (Barbaro, 2010; Stoddart, 2020b, Figure 7.4) (Figure 6). Once this transfer took place, there is the further discussion about the nature of the new political entities that formed on the larger plateau of Etruria (di Gennaro, 1986; Pacciarelli, 2000, 2017; Vanzetti, 2002, 2004; Stoddart, 2020b). Was the occupation of the plateaux multi-focal and thus visibly heterarchical (Ward-Perkins, 1961; Rendeli, 1991) or was the occupation immediately gathered together under one unitary political authority (Guidi, 1989; di Gennaro et al., 2004)? In spite of the substantial consensus by protohistorians studying the Villanovan material culture, it is highly probable that a tension

remained between the need for cooperation in the plateau and the constituent institutions that made up that community. This was a tension that continued to be present in the later Etruscan communities, where the central institutions of the descent groups competed for political attention with the requirement to act together as one supra community. Distinct neighborhoods in urban entities are a common phenomenon cross culturally (Smith, 2010), but recognizing them from what remains largely surface scatters of material in the case of central Italy is a first problem, even before defining what they represent in social and political terms. Given the formation process of Etruscan nucleation combined with the available evidence, it is highly probable that clustered neighborhoods were retained long into the formation of the city. The evidence from the two cities,

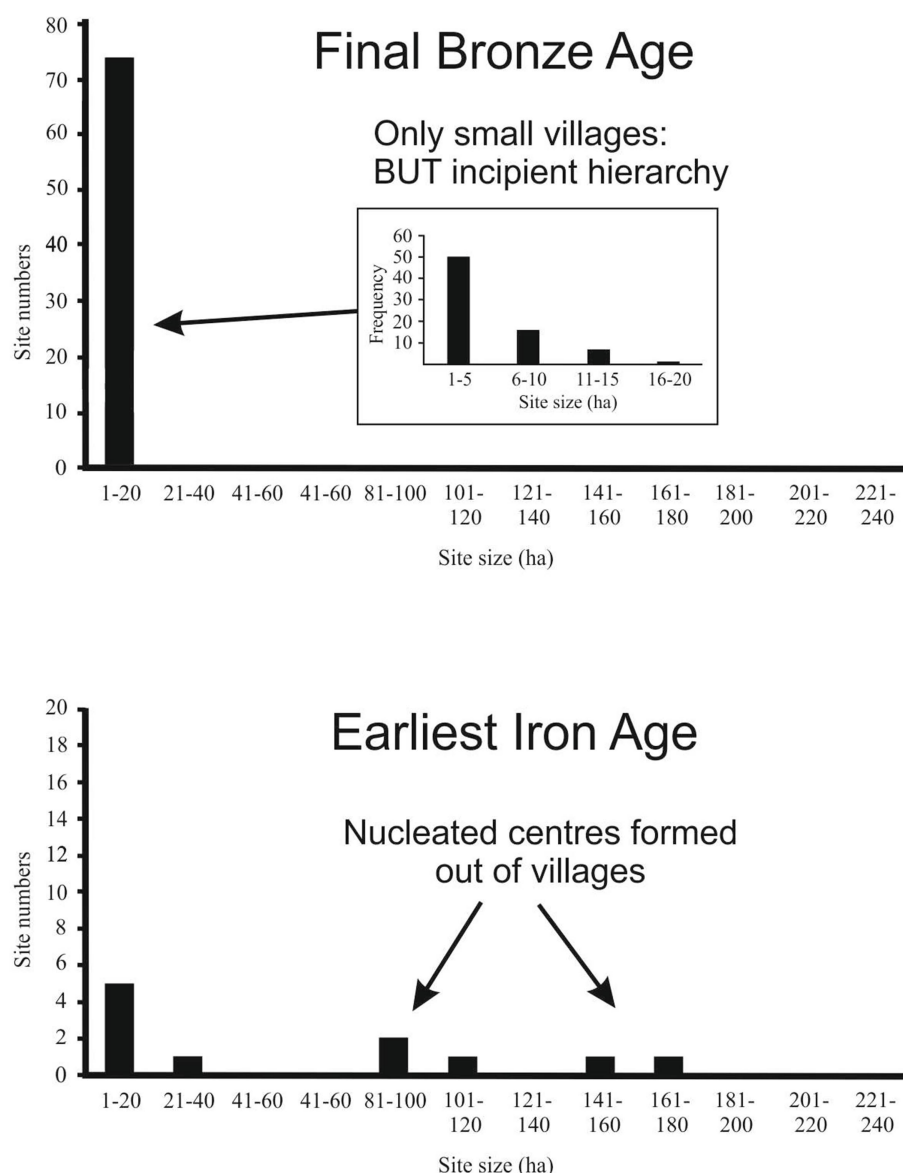


FIGURE 6

Change in distribution of settlement size between village and nucleated phase. (Data from [Barbaro, 2010](#)). Source: Simon Stoddart.

Tarquiniia and Veii, which have been systematically studied both by geophysics and surface survey do seem to confirm the idea of the enduring neighborhood, with open spaces ([Smith, 2008](#)), born out of the very nature of the nucleation process from a series of separate villages (cf. [Samuels et al., 2021](#)). At a later stage, both were subjected to an attempt to formalize the structure of the city around a series of monumental ritual structures.

In our view, the Etruscan nucleation retained a strong element of social fractality, repeating similar structures both at a higher and lower order. This relates directly to the formation process from a series of villages, composed themselves of a series of descent groups. These villages can still be detected in the surface surveys of the nucleated centers. Each overarching nucleation in turn appeared to have had a putative ancestor. Some names, such as Tarchon in Tarquiniia have come down to us ([Nielson, 1984](#); [Muse, 2007](#); [Bagnasco et al., 2013](#)). At a higher

order scale, the nucleated centers themselves collectively formed a competing network generally designated as Etruscan, perhaps centered around collective ritual (see below), contrasting with other collective identities, most particularly the Latins to the South.

To this we can add the view that the period of change was a phase of uncertainty in the Mediterranean which required special measures of ensuring security ([Briquel, 2000](#)), an opinion shared by [Zanini \(2012\)](#). This uncertainty may have been episodic in the early phases of nucleation, since modelling radiocarbon suggests a drop in demography at about 800 BC, well into the development of nucleation ([Parkinson et al., 2021](#)). Another dimension is the scale at which the context of nucleation needs to be considered. One wider scale relates to the Mediterranean. Another is the scale of the Italian peninsula. In this respect, we may be dealing with substantial shifts in population density from the Po Plain to

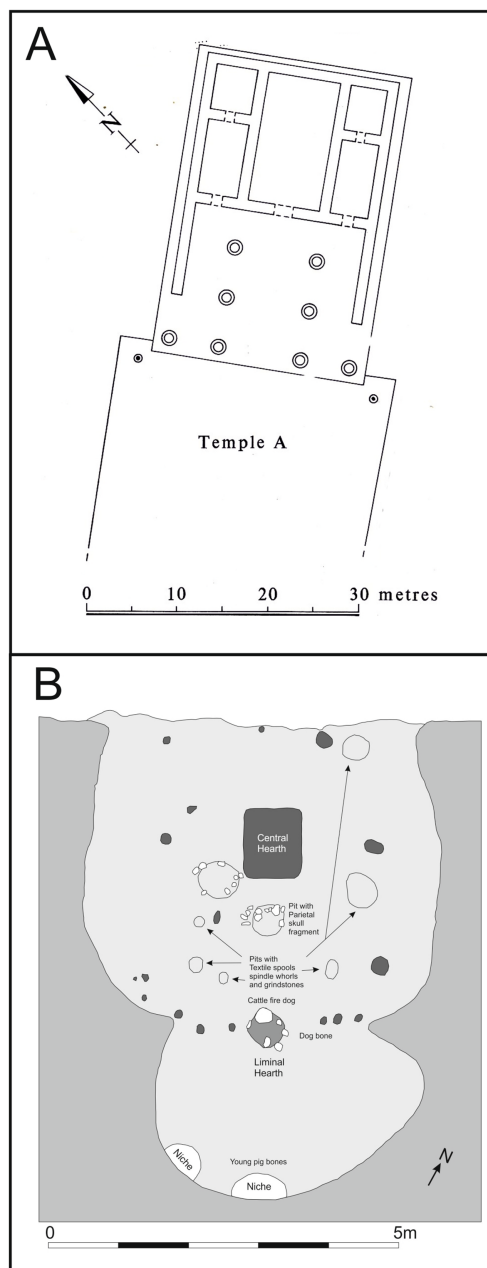


FIGURE 7
(A) Temple A at Pyrgi, a port of trade from the period of nucleation.
(B) Embedded ritual at Sorgenti della Nova, a village site dating to the period before nucleation. (B) After Cardosa and Pitoni (2012). Source: Simon Stoddart.

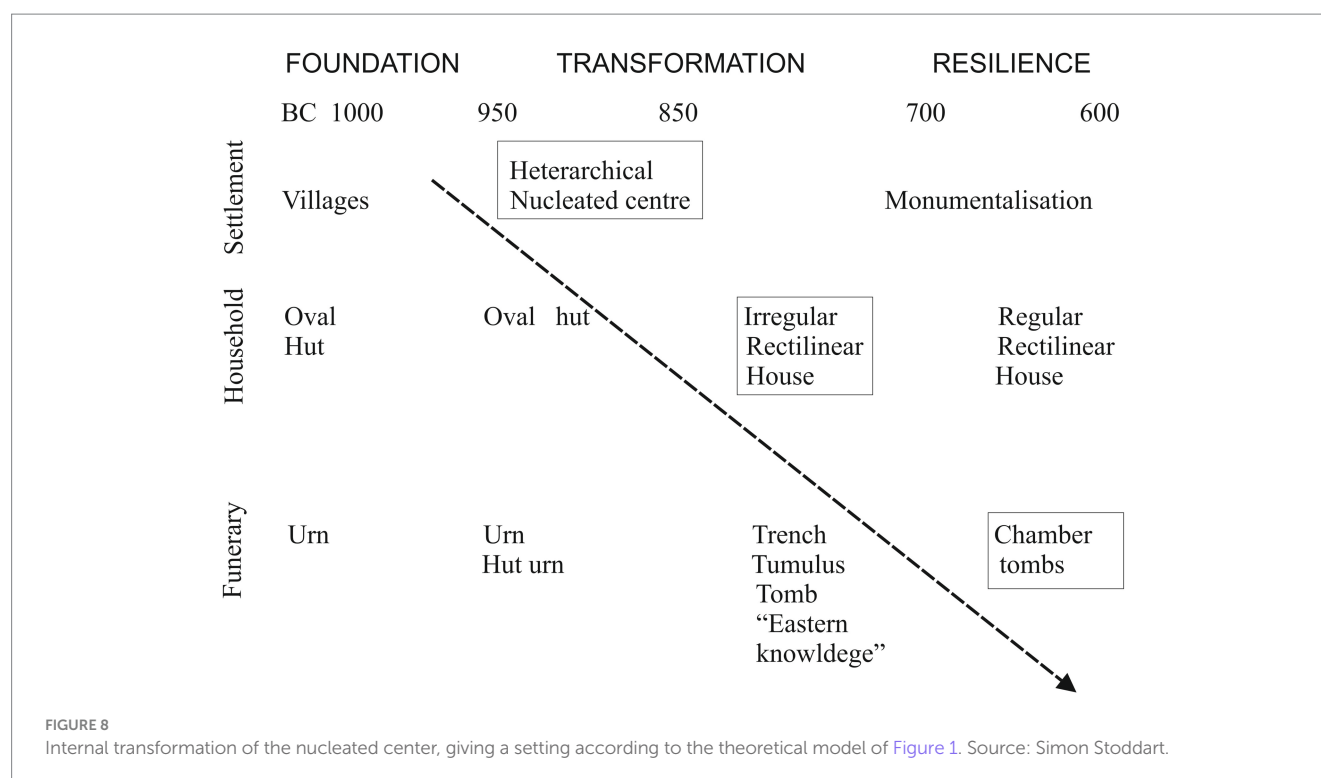
central Italy (Zanini, 2012) although these shifts may have primarily affected the inland areas, as explored in more detail of material culture by Cardarelli (2009). An implementation of this argument to ensure the safety of people and resources has been applied as an agent-based model to explain nucleation (Cecconi et al., 2015), but notably this has been applied to Tyrrhenian Southern Etruria, an area where communities may have been aware of the demographic instability to the north, and responded accordingly with a repeated nucleated response. Rites of foundation are more easily found in the smaller nucleated villages

of Etruria, since they were abandoned when the larger nucleations took place at the very end of the Bronze Age and the very beginning of the Iron Age. This has allowed extensive excavation in a way that will be never be achieved in the primate cities of the Iron Age. The prime example is that of Sorgenti della Nova (Figure 7B), which has been excavated for some 30 years like the more southerly city of Tarquinia by the University of Milan. The excavators have also deliberately undertaken an open area strategy of the relatively shallow stratigraphy and revealed what they quite reasonably suggest are embedded domestic rituals, focused ritual activity and foundation rituals. The focused ritual activity relates to two artificial caves with a hearth associated with a high quantity of piglet bones (unusual for the period) (Cardosa and Pitone, 2012). Another less well-defined example within a settlement is at Poggio Buco (Setti and Zanini, 1998). This form of ritual was contemporary with the deposit of metal hoards and structured middens, often full of feasting deposits and even with metal work. The deposit of hoards continued into the period of more substantial nucleation.

Rites of foundation have also been identified in the later nucleated cities (Michetti, 2013) while the deposits of hoards appear to have ceased. The most remarkable case is that of the *complesso monumentale* on the Civita of Tarquinia, where deliberate deposits were found in the early seventh century BC of an axe, a trumpet and a shield (Bonghi Jovino, 2010). These are very redolent symbols of offence/punishment, defense and alarm, which require little translation, particularly when found in deliberate association. The sequence from the Bronze Age to the Roman in Tarquinia is interpreted by the excavators as memorialized sequence that runs from a *mundus* cavity in the tenth century, accompanied by continuous memorialization of structures, offerings and human remains, with an increasing formalization through time. The presence of inhumed human remains within the community both at Tarquinia and on a smaller scale in Veii, is particularly telling since the habitual rite of burial of the time was cremation, in large cemeteries placed on the boundary of the city. The material remains of these rites have been closely linked to written sources at Tarquinia, which report sacred books, and the layout of the city mirroring the interpretation of the celestial sky. On the ground the most elaborate schemes have been detected in later cities such as Marzabotto (Figure 5) where an initial rite of foundation was crystallized in the layout of the city and temples along rectilinear lines.

3.2 Transformation, resilience and expansion

The Etruscan city typically underwent a process of transformation (Figure 8), increased resilience and expansion over the period 800 to 500 BC. The transformation had a considerable internal impact on the internal organization of the city. As far as the limited open area excavations allow us to interpret, the heterarchical village structure mirrored by oval huts in clusters across the settlement plateau was gradually formalized into a more rectilinear format (Figure 9) (Brandt and Karlsson, 2001; Miller, 2017; Bruder, 2022). This process appears to have been anticipated by the internal organization of the city, and



then followed in sequence by the individual component parts (the household buildings) and finally the places of burial, which alluded to earlier memories. The layout of rural buildings subsequently followed the same trends (Malone et al., 2014).

Further excavation is needed in the domestic areas of the city, as opposed to the ritual zones, to substantiate this model of development. Additionally, the limited application of archeological soil and sediment micromorphology, along with other micro-analytical techniques (e.g., μ FTIR and μ XRF) (e.g., Brönnimann et al., 2020; Karkanias and Van de Moortel, 2014; Nicosia et al., 2022), hinders the precise reconstruction of changing human behaviours and spatial usage within settlement areas. The nature of the foundation and transformation processes, particularly in terms of continuity and change within the archeological sedimentary record, largely remains to be investigated. At present, we only have a detailed understanding the transformation of the places of burial into formalized structures that increasingly represented the descent group through time, supported by social genealogies of inscriptions (Figure 2), which occur in most of the cities, but perhaps have been most clearly illustrated by the urban cemetery of the Crocefisso del Tufo at Orvieto. Here the urban layout is very clear, and each tomb of a descent group is clearly indicated by the family inscription over the door (Bizzarri, 1962, 1966).

The transformation of the countryside was equally evident (Figure 10). Whereas the foundation of the nucleation had led to substantial clearance of the countryside, the period's transformation and resilience led to a reoccupation of the countryside with rural settlement. The most dramatic effects can be registered in the coastal southern cities, particularly where these coincide with substantial survey activity. The

prime example is that of Cerveteri whose eastern territory has been extensively surveyed (Cerveteri, 1993; Enei, 2001) and subsequently assessed in a systematic comparative manner (Zeviani, 2023). The peak of occupation appears generally to have occurred in the sixth century BC, substantially adding to the resilience of the city by establishing a network of smaller productive agricultural sites in its territory, and then retracted in the following period, before expanding again in the period (not illustrated here) before Roman incorporation. This contrasts with Chiusi (Figure 11) where a more distributed organization of the landscape was achieved. The outcome was generally a strikingly primate organization of the landscape, where the largest center dominated its surrounding countryside (Figure 12).

3.3 Dissolution

The level of dissolution of the Etruscan was highly variable. Some cities such as Veii were subjected to much discussion in the Roman sources (especially Livy) as subject to a veritable dismantling by military means. Others such as Tarquinia definitely had a decline, but can be defined by a much gentler transition. Furthermore, northern cities such as Arezzo were incorporated into the Roman system, become part of major ceramic production that is very visible in the archeological record. Terrenato (2019)'s argument is very telling that the Roman strategy was as much persuasion as coercion, operating crucially within the institution of the descent group, that residual heterarchy, which could be peeled off from any centralizing forces of the nucleation. The Roman strategy depended on many factors, including the degree of centralized nucleation by each center.

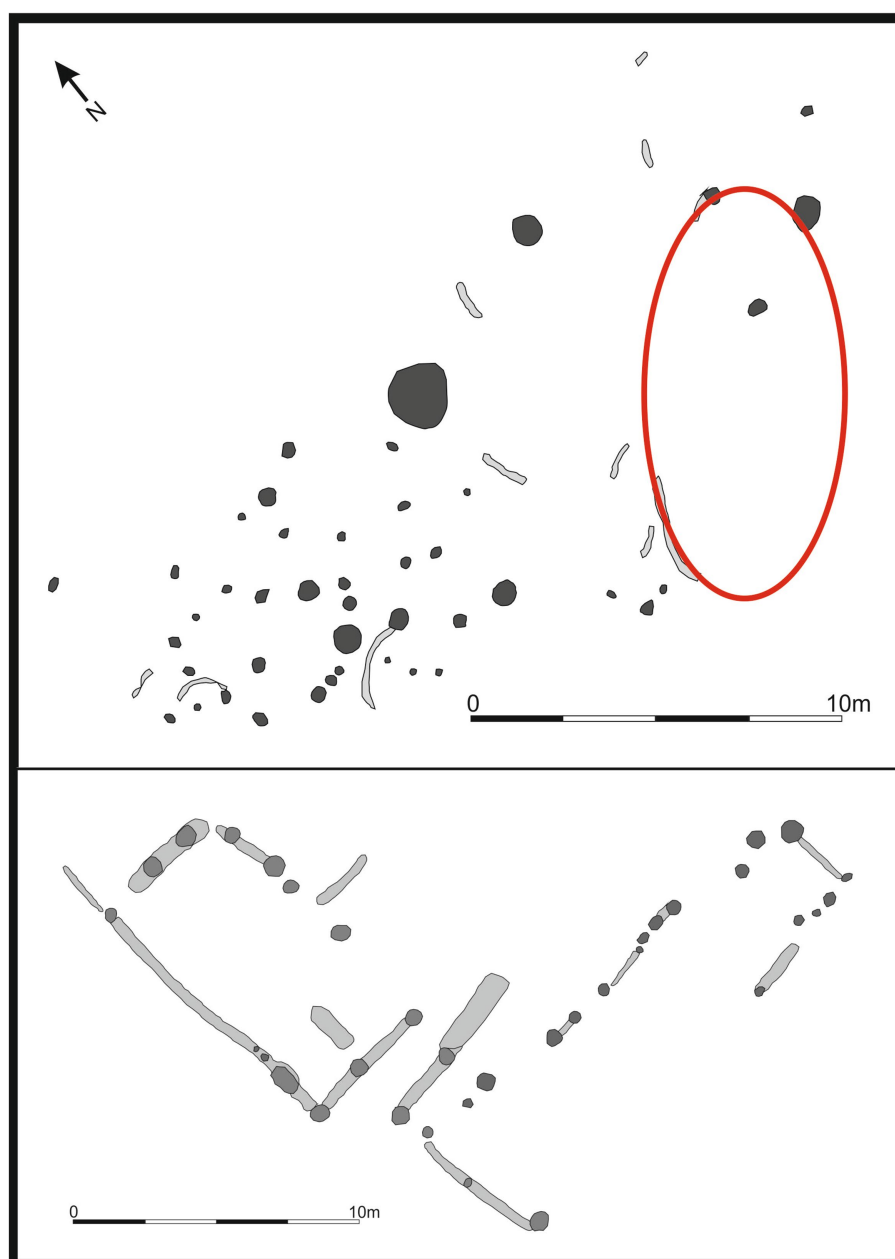


FIGURE 9
Structural transformation within the nucleated center of Veii. Above: Nucleation. Below Consolidation. After [Tabolli and Cerasuolo \(2019\)](#). Source: Simon Stoddart.

4 Resilience

4.1 Ritual

The historiographical traditions of Etruscan research have uncovered ritual structures in almost all the major Etruscan cities. The cities of Tarquinia (already discussed) and Veii provide the paramount examples. However, all the major Etruscan cities have ritual deposits that became more formalized and ritualized in the course of time. Orvieto is an interesting example because the well-defined plateau has a substantial number of temples, that suggest a continued point of reference to the original constituent parts of the

original nucleation. Perugia on the eastern frontier has rather later deposits that only in the course of time became more formalized and focal to the community. These relatively well understood data suggest that the process of ritualization had a degree of spatial differentiation, ranging from early developments in the “glocalized” coastal cities to the later more heterarchical patterns within the inland nucleations, mirroring the patterns of territorial control by the same nucleations.

Sanctuaries (and the temples contained within them; [Figure 7A](#)) are traditionally considered the key institutions in the Etruscan community, “a social nexus ... a place for meeting and social competition” ([Becker, 2008](#), p. 87) and redistribution ([Becker, 2008](#),

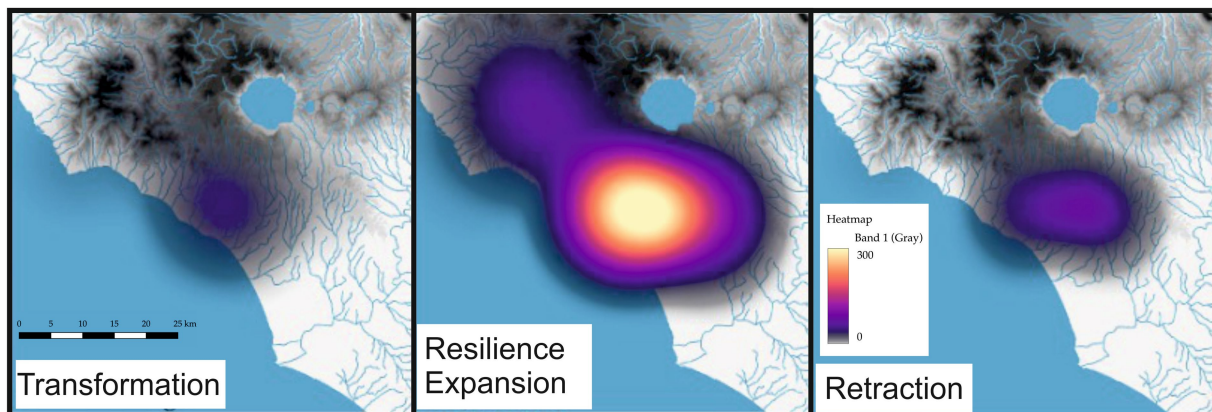


FIGURE 10

Changes in the countryside around Cerveteri (Zeviani, 2023), giving a setting according to the theoretical model of Figure 1.

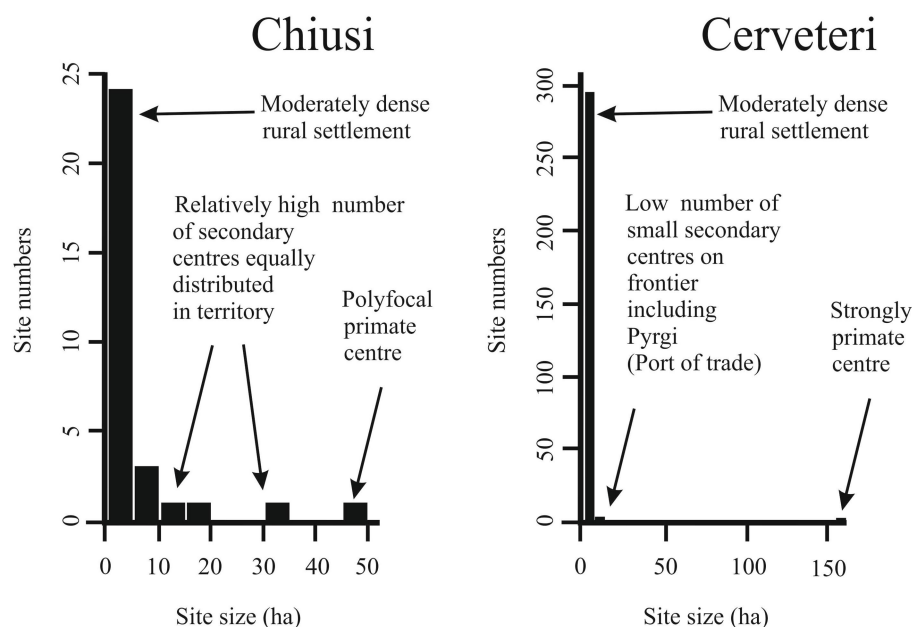


FIGURE 11

The contrasting distribution of settlement size between Chiusi and Cerveteri. Stoddart (2020a) interprets the size of Chiusi from its polyfocal format, reducing some estimates of the nucleated center's size.

p. 97). Study of these reveals the prominence of leading members of descent groups (particularly men) in making dedications, thus emphasizing the continuing heterarchical nature of decision making (cf. Jannot, 2005, p. 82), within an institutional framework. Dedications by the community itself are more difficult to establish although they have been inferred by drawing on Greek parallels, a dangerous comparison within a different cultural milieu. In the later periods, it is very probable that there was an over-arching ritual institutional framework (Tagliamonte, 2017, pp. 134–136), plausibly coordinated from the Fanum Voltumnae, that has been located (and excavated (Stopponi, 2011)) near Orvieto, in a geopolitically rational point in Etruria.

4.2 Subsistence

A major precondition for the nucleation processes is resilient farming systems endowed with the capacity to support not only the growing demographics, but also the emerging sector of non-agricultural specialists (trade, seafaring, metallurgy, pottery, architecture, etc.) that became a defining factor for Etruscan urbanism.

In spite of the largely later iconographic and material evidence from Etruscan tombs, which intimate high levels of meat consumption, isotopic investigations are beginning to outline a more nuanced picture of past domestic consumption. The isotopic

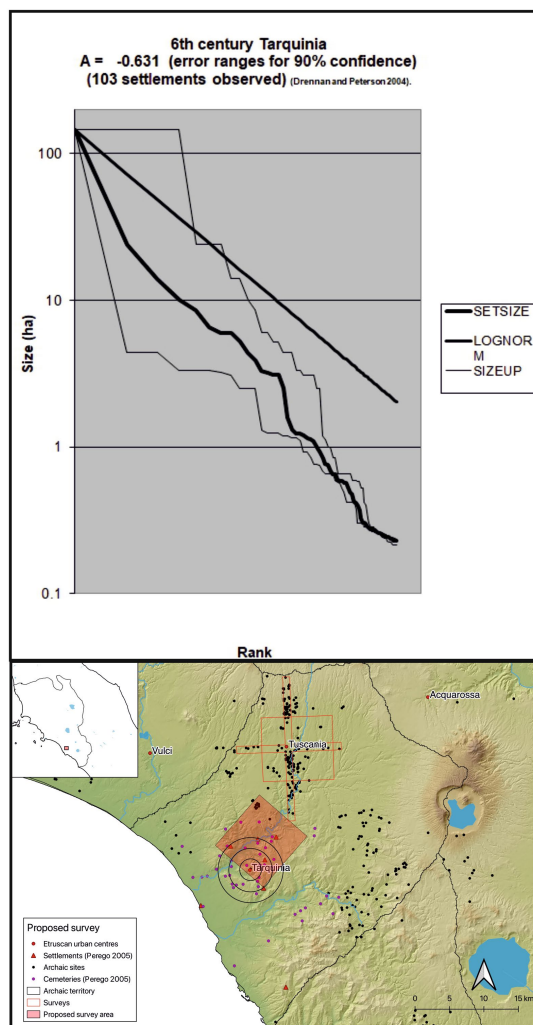


FIGURE 12
 Tarquinia. Rank size distribution and spatial distribution. Above: Rank size of sites where size can be calculated drawing on Stoddart (2020a) and Zeviani (2023). Below: Rural data from Zeviani (2023).

data at Fermo (Esposito et al., 2023) and Pontecagnano (Ricconi et al., 2024) – two Villanovan/Etruscan sites located outside the main Etruscan territory of central Italy – revealed that individuals had a relatively homogenous diet, consuming C3 plants, with limited intake of animal proteins and no, or negligible, marine food consumption. At Pontecagnano, millet was contributing to the maternal diet and breastfeeding, as well as supplementing infants and children's diets. By contrast, six individuals from Tarquinia (Bagnasco et al., 2024) – despite the very small sample number and allowing for their likely deviant status – had a wide range of diets from terrestrial to marine, often with a predominance of plant-based foods contributing to the terrestrial portion.

As in most agrarian societies, crop husbandry was the principal provider of human sustenance, but, despite its fundamental role, the direct archaeobotanical evidence for farming is still underrepresented in discussions of Etruscan urban formation and systematic recovery of plant remains is not commonly applied in fieldwork (Shriver-Rice and Schmidt, 2022). The study of late second millennium and early first millennium BC animal husbandry has been more developed

(De Grossi Mazzorin, 2001; Minniti, 2012; Trentacoste and Lodwick, 2023; Stoddart, 2024). For this reason, we can perhaps give a greater statement of trends in animal as compared with crop husbandry. Evidence for the nature of marine resource exploitation is sparse as a consequence of a lack of systematic flotation, but where present, fish exploitation appears largely locally orientated, with fish consumption also conditioned by local food traditions (Russ and Trentacoste, 2021).

Animal rearing appears to transition to an economy more focused on secondary products, pig rearing and later chicken, as urban forms of production took hold (Trentacoste, 2020), and emphasis on pig production greatly intensified in the Roman period (De Grossi Mazzorin and Minniti, 2023). This process, however, was not linear or wholesale (e.g., Moses, 2020). In terms of the ecology of animal grazing, pilot isotopic work demonstrated inter-site differences in livestock herding strategies, which were argued to reflect the impact of distinct socio-economic contexts on land use and mobility (Trentacoste et al., 2020). Such work raises questions on the organization of late pre- and proto-historic animal herding patterns and mobility and how they intersect with collective action through the use and management of common grazing areas (Kanne et al., 2024; Haughton and Løvschal, 2023). Common grazing lands have been suggested for prehistoric northern Europe (Haughton and Løvschal, 2023), and the existence of such areas is to be inferred in the traditional view of the central Italian Bronze Age as a predominantly 'pastoral' society, in which the economy and community interaction were centered on seasonal transhumance (Puglisi, 1959). Bronze Age transhumance remains accepted in the literature, based on similarities between ceramic styles been suggested summer and winter zones (e.g., Barker, 1981; Cavazzuti and Putzolo, 2015). In this interpretation, the role of peripheral heathlands in northern Europe may be analogue to Apennine and Sub-Apennine uplands, with the funerary barrows of northern Europe functioning similarly to 'Opferplätze' (e.g., Malone and Stoddart, 1994), matching the large cultural zones of inland Chiusi-Umbria area on the one hand and the Tolfa Allumiere zone on the other (Zanini, 2012).

Nucleation, and the more geopolitical and territorial approach that accompanied it, would be expected to have significant impacts on rights-of-way and access to natural resources that underpin herding systems. Assuming relatively free movement in the later Bronze Age, as proposed in traditional models, the capacity to achieve relatively long-distance mobility would potentially be interrupted by the political concerns of competing nucleated centers. Recent work, however, has begun to challenge the ubiquity of long-distance Apennine transhumance, and instead had emphasized more locally and regionally focused forms of management (Trentacoste et al., 2020; Trentacoste et al., 2023). If fairly locally constrained, nucleation and control over a larger territory may have allowed larger centers to negotiate more distant upland grazing, or at least draw animal capital from a wider radius (Trentacoste et al., 2021). In the subsequent Roman period, this negotiation would have become much more achievable, if political and economic frictions on mobility were eased (Trentacoste et al., 2021).

Macrobotanical remains have so far been collected from over twenty Etruscan sites, although with strong variation in the quality of recovery and consequently also the interpretative strength of the data. Figure 13 summarizes the occurrence of cereals and pulses on sites that have produced relevant evidence.

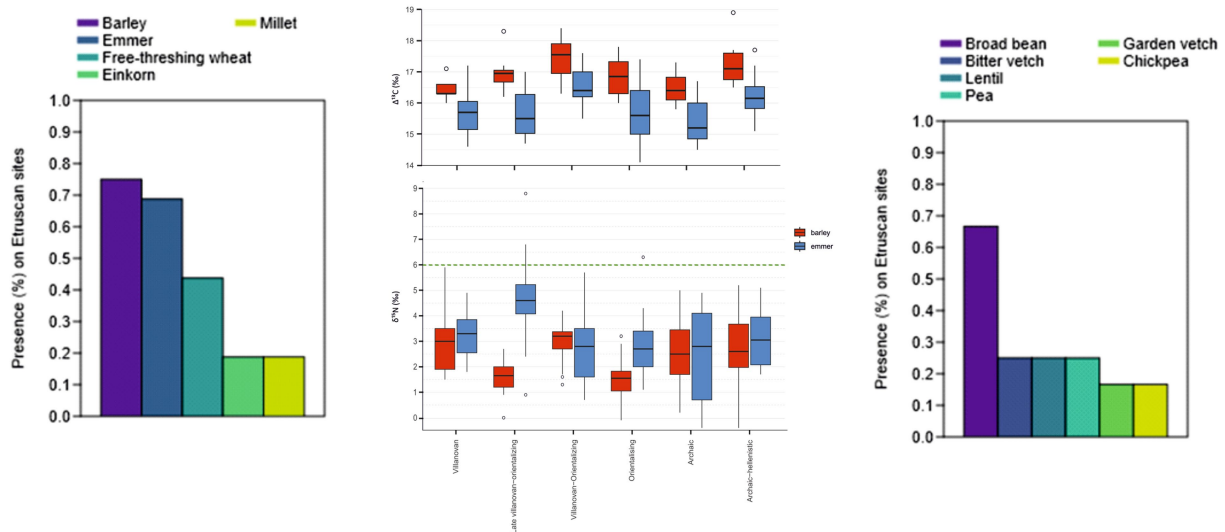


FIGURE 13

The evidence for plant agriculture in Etruria. From left to right: Percentage presence of cereals on sampled Etruscan sites; isotope values in cereals from Tarquinia (carbon (above) and nitrogen (below)); and percentage presence of legumes on sampled Etruscan sites. Source: Carbonised plant remains - Schmidt (2025); isotopes- Fanny Gaveriaux.

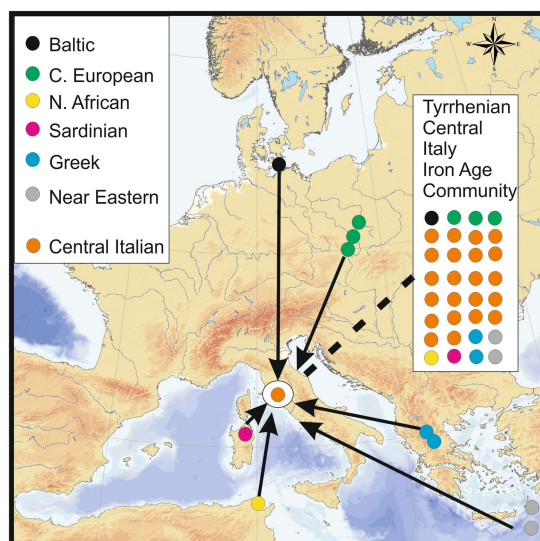


FIGURE 14

aDNA evidence for nucleation, showing the principally Italian genetics of the central Italian population After Moots et al. (2023) with additions. Source: Simon Stoddart.

The choice of staple crops seems to have drawn on long experiences of the local landscape, minimizing risk and seeking resilience. A consistent focus on emmer, barley, and broad bean is discernible, which broadly continues a trend observable on the Italian peninsula at least since the Bronze Age (Motta and Beydler, 2021). These three staples are supplemented by a diverse range of secondary domesticates, which collectively do not, though, seem to have had a major impact on subsistence.

At Tarquinia the recent application of systematic sampling for the retrieval of archaeobotanical material and of isotopic analysis

on cereal grains has been crucial to test the resilience of the nucleation process. Tens of thousands of crop remains have allowed, for the first time, more delicate insights into the organization of cereal farming between the ninth and sixth century BC. The isotopic work in combination with functional ecology of the weedy flora shows that the input from manuring, irrigation, and other forms of intensive management practices on cultivation remained low-key throughout these centuries. Nitrogen and carbon isotopic analysis on emmer and barley indicates that they were likely cultivated in similar environmental conditions. Furthermore, the data do not show any notable variation over time, suggesting that cultivation practices and environmental factors remained relatively consistent throughout the period of initial nucleation and its maintenance (Figure 13). It is remarkable that similar low input agricultural practices during the nucleation phase have been identified also at Gabii, a Latin settlement east of Rome and the only other site in the region where systematic sampling and isotopic analysis are an integral part of the research design (Gavériaux et al., 2024).

This cumulative evidence translates into a farming system in which the necessary yields and consequent resilience of the nucleated community were achieved via the extensification of agricultural land. Farming systems relying on extensification are observed across Eurasia as a key component in urbanization processes since they allow an increase in production with low labor input, once political protection of expanding arable land is in place (Bogaard et al., 2018; Styring et al., 2017).

The edaphic signal of the weeds from Tarquinia reveals a primary focus on the nearby floodplain of the Marta River during the period in question. Beyond providing a secure and sustainable environment, the landform has a spatially limited extent around the immediate site catchment and would further have fueled the need to reinforce influences on the wider landscape under periods of demographic growth.

From the fifth century BC and onwards, when the formation of the city consolidated with more centralized institutions, archaeobotanical evidence becomes diffuse, but isotopic signals from cereals imply that farming regimes based on low input continued to remain the *modus operandi*, most likely coupled with more intertwined supply networks from rural production that is mediated through subsidiary centers in the hinterlands of Tarquinia's territory (Zeviani et al., 2025).

Arboriculture became another important aspect of Etruscan farming economies, especially regarding the Mediterranean staples vines, olives, and perhaps figs. Intensity and practices are less visible in the archaeobotanical record, but, at least in the case of vine, dispersal rates of Etruscan amphora show that by the sixth century BC production scales were reached that facilitated systematic export outside Etruria (Perkins, 2012; Dodd, 2022). Additionally, by this time, a range of native wild trees may have become subject to more formal management, possibly even cultivation, and including taxa such as hazel, pines, and cornelian cherry.

Beyond diversifying farming systems and enabling the exploitation of new landscapes, intensive arboriculture has shown to be closely linked to urbanization processes, as resilient territoriality and its political protection is required for these long-living and immobile crops, that in turn provide resources with high return rates when integrated into exchange networks (Fuller and Stevens, 2019; Gilman, 1981). More centralized institutions, beyond the descent group, may have been required to achieve these ends.

The combined data highlight how the provision of the consolidating cities became increasingly dependent on renegotiating the wider landscape. Whereas village societies of the Bronze Age principally managed to be sustained by their immediate surroundings and were considerably more mobile because of their focus on annual crops, the nucleated sites were not only gradually exceeding their local capacity, but also increasingly invested in perennials whose productivity required transgenerational stability. The outcome is a hierarchized and politicized landscape in which the nucleus remains the stable seat of power, with the accompanying institution. Tarquinia is a prime example of such a nucleus where we can now more closely reproduce the agricultural forces behind expansion. Here influences follow the Marta River which provided both arable land and communication routes, and in the further hinterlands power eventually was fanned out along the dendritic river catchment where subsidiary centers on fertile volcanic soils likely became crucial agents in supplies of the city.

4.3 Impact on the landscape

The nucleated centers occupied a varied natural landscape, although some suggest that central Italy was favored by wetter conditions within a more broadly dry landscape in the Mediterranean at c. 1000 BC (Finné et al., 2019). The southern and larger nucleated cities of the south generally occupied a volcanic landscape, with rich potential for agricultural production, perennial access to water, good sources of clays for ceramics and architectural enhancement, woodland for fuel and mineral extraction. The northern and inland cities were often situated in zones of more easily eroded sedimentary deposits, bordered by substantial tectonic valleys. Combined with

distance from the “globalized” Mediterranean, these factors had a profound effect on the background and even intensity of nucleation.

The level of understanding of the impact on the landscape is relatively limited at this stage after a strong start in the 1960s (Judson, 1963, 1968; Alvarez, 1972; Cherkauer, 1976; Shriver-Rice et al., 2025). The high level of erosion from Roman times onwards has tended to shroud the earlier alluvial deposits (Brown and Ellis, 1995; Stoddart and Malone, 2022; Barker et al., 2023). The deposits are also rather difficult to date, since many of the ceramics and even radiocarbon can be substantially residual and therefore not precisely linked to the processes under study. These are long-standing challenges in the context of alluvial valleys across the Italian Peninsula (e.g., Hunt, 1995) that have led to preliminary assessments indicating that the destabilization of the landscape was not as serious as in later periods. However, no explicit project has trenched sufficiently deeply to reach any possible deep alluvial deposits, except possibly in some of the river valleys, or focused on different kinds of sedimentary archives. Such alternatives include the understanding of the soil evolution across the nucleated plateau as influenced by the aggregation and disaggregation episodes, linked with localized evidence of landscape transformation as indicated by slope deposits. These local archives could also curb the difficulties of assessing the level of damage to the landscape by the level of agriculture already outlined and disentangling anthropic influence from that of climate and base-level adjustments in fluvial records (Butzer, 2005; Fuchs, 2007; Wolf and Faust, 2015).

However, dynamic systems like soils, buried or not, and slope materials present important dating challenges, although the use of Optically Stimulated Luminescence (OSL) techniques can overcome the mobility, residuality, and calibration issues of radiocarbon dating. While this has only been used to a very limited extent in central Italy (Barker et al., 2023), recent work is pointing to landscape impacts as early as the late sixth century BC in both the Tiber delta and low-lying parts of Rome (Brock et al., 2021; Brock et al., 2025; D'Orefice et al., 2022). Furthermore, in the lower reaches of the Albegna valley, OSL dating and pollen analysis have been combined to produce greater detail of potential human impact on the lower reaches of the riverine systems that were clearly so important for Etruscan agricultural systems (D'Orefice et al., 2022).

The broader understanding is supported by the generalized studies of vegetational change for the central Italian area (Stoddart et al., 2019). This multi-proxy evidence, but mainly based on pollen, once again indicates no clear correlation between the presence of rural settlement and the removal of vegetation beyond what had already been removed in earlier periods. However, once again, the evidence is relatively tenuous, because only one pollen core at Lago dell'Accesa is placed in the near proximity of a settlement (Drescher-Schneider et al., 2007). Pollen samples taken from two farms at Val Petraia and Pian d'Alma, from furnaces for iron ore reduction at Rondelli, from a necropolis at Populonia (Lippi et al., 2000; Sadori et al., 2010) when combined with Late Etruscan evidence of charcoal and seeds/fruits (Di Pasquale, 2003; Buonincontri et al., 2013) showed that, during the Etruscan period, the immediate environs of sites had some clearance. The recent analysis of a well in the Chianti area suggests clearance of the oak forest on a substantial basis only in the late Etruscan period (Mariotti Lippi et al., 2020). The study of a *domus* of similar late Etruscan date from Vetulonia shows the exploitation of a wide range

of woods, both local and more distant from Monte Amiata, but it is difficult to assess the impact on local vegetation (Coradeschi et al., 2021).

The Roman expansion brought a much more intense utilization of the landscape that can be measured along a wide range of dimensions (Stoddart et al., 2019). These include the drainage and reorganization of the landscape (de Haas, 2017), even if this approach had started in selective regions such as around Veii at an earlier stage in the Etruscan period (Judson and Kahane, 1963; Bergamini, 1991).

5 Interaction from a material and biological perspective

The material evidence of the interaction of Etruscan communities has been studied in very great detail, filling many of the museums of the Western world. It is a piece of evidence closely linked to the production, consumption and display of pottery and metalwork in tombs and sanctuaries. It would be a disservice to this great cultural tradition to try to summarize the evidence here. By contrast, the bioarcheology of urbanism (Betsinger and DeWitte, 2020) is a developing field which is beginning to have its impact on our understanding of Etruscan nucleated centers in two principal areas: mobility and diversity.

5.1 Mobility

It is generally accepted from studies of more modern times (Wrigley, 1967; Stoddart et al. in preparation) that nucleation (and indeed urbanism) required a constant supply of population, not only to provide the original concentration of population, but also to retain population numbers, in the face of low fertility, disease and even emigration. In spite of major differences in the characterization of urban life in the classical past, and amongst the Etruscans in particular, similar factors are assumed to have operated. Through the application of isotope and aDNA analysis, even if plagued by small sample size, difficulties of chronology and the complications of differential funerary practice (notably cremation vs. inhumation), it is beginning to be possible to differentiate between different scales of mobility. The employment of multi proxy approaches on larger sample sizes is the way forward, providing not only an ancestral “stratigraphy,” but also movement in different stages of the life course.

5.2 The genetics of diversity

Recent research on the genetics of nucleation has made major strides at both a macro and micro level. The work has moved on from the study of modern populations of humans (Achilli et al., 2007) and animals (Pellecchia et al., 2007) in the pursuit of *Ancient Origins*, without chronological control, toward a more detailed and precise analysis of ancient DNA. A half-way house is provided by the comparison of ancient mitochondrial DNA from human remains and that of modern populations, implemented in this way because of the early state of the art and the lack of large sample sizes (Vernesi et al., 2004; Ghirotto et al., 2013). The first study engaged with 17 samples from the core Etruscan area between the Arno and the Tiber, and was able to define, within the limits of the available date, that the samples

studied were a coherent biological population, showing a characteristic mitochondrial diversity for the region over time. The same data were employed for a more detailed study of the relationship between ancient and modern populations (Malyarchuk and Rogozin, 2004). The second study which shows a mixed picture where the Casentino, a well-defined mountain tectonic valley, illustrates the best case for continuity of female descent, even if this valley had a less distinct Etruscan identity in the past. Other areas of Tuscany presenting increasing degrees of later mobility which led to population replacement. A third mitochondrial study investigated the Umbrian area, displaying the high degree of variation (Modi et al., 2020), that one might expect from an area that was less distinctive both culturally and in terms of the processes of nucleation, contra the textual sources which emphasize the ancient character of the Umbrians as a distinct entity rather than a residual category (Stoddart and Redhouse, 2014). Larger scale aDNA studies carried out over the last decade have shown that mitochondrial haplogroups are diverse within Iron Age Italy, and within populations from different regions and material cultures. Mitochondrial haplogroup profiles do not seem to distinguish between individuals from different Italic archeological contexts, nor to rule out continuity between Iron Age populations and modern populations (Posth et al., 2021; Ravasini et al., 2024; Antonio et al., 2019; Bagnasco et al., 2024).

In these early studies, and indeed in many later studies, the full collaboration between archeologists and geneticists appears to be largely missing. There is a preoccupation with the issue of origins, drawn from early archeological literature and debates in the written sources, which does not have such a sound characterization for anthropological archeology. The Vernesi study contained just one bioarchaeologist accustomed to studying archeological material, and cited relatively generic archeological sources. The Ghirotto team contained no archeologists and cited generic archeological sources. It is essential that the archeological and genetic context are considered in equal measure and that questions are posed from both disciplinary perspectives. More recent analyses tend to have many more details of the archeological context (especially in the supplementary materials where individual samples can usually be identified alongside chronological and cultural data) supported by a wider archeological authorship, which allows a much deeper interpretation at multiple scales of analysis (e.g., Posth et al., 2021).

In a number of aDNA studies from mainland Italy and Sicily the presence of Bronze Age Steppe-related ancestry has been confirmed by the end of the third millennium BC, though the proportion of this ancestry is very heterogeneous between individuals (Fernandes et al., 2020; Saupe et al., 2021; Moots et al., 2023). These newly sequenced individuals also demonstrate a shift in Y-chromosome lineages, with the appearance of R1b-M269 derived haplogroups, though the Y-chromosome haplogroups more common in the Neolithic do not disappear entirely. Beginning with the first large-scale aDNA study of Italy in Antonio et al., 2019, a marked increase in genetic heterogeneity in populations is noted, starting in the Iron Age. A number of Iron Age individuals have been found across a range of archeological contexts who carry ancestry similar to individuals from regions outside Italy, including the Baltic Sea region, Central Europe, North Africa, and the east Mediterranean (Bagnasco et al., 2024; Antonio et al., 2019; Antonio et al., 2024; Posth et al., 2021), as would be consistent with the increased biological interaction of urban societies (Nalls et al., 2009), engaged in the process of nucleation

(Antonio et al., 2019, Supplementary Figure S6). Larger, that is nucleated, populations have fewer, shorter runs of homozygosity (ROH), whereas isolated or bottlenecked populations have more, somewhat longer ROH (Ceballos et al., 2018), although this needs to be thoroughly checked with larger sample sizes. The Posth et al., 2021 study from a small sample of 14 individuals securely dated to before 500 BC, nevertheless suggests the essential coherence of the genetic group at this time, with a broadly Italian ancestry, with the exception of one individual with a central European ancestry.

Micro-analysis has shown the coherence of descent groups demonstrating the biological reinforcement of family identity through time. An analysis of one of the tomb groups in the Monterozzi cemetery at Tarquinia demonstrated, as expected, that some members were related through the female line (Cappellini et al., 2003, 2004) using mitochondrial DNA. The Posth et al., 2021 work is a longitudinal population study across 2000 years of history. It is mainly a population study, but at the late Etruscan site of Casenovole recent, but disturbed, excavations uncovered family groups within family tombs, composed of four individuals with first- or second-degree relationships, where one had central European ancestry. A collection of skulls from the nineteenth century preserved in Leipzig from Tarquinia (most probably Monterozzi) equally demonstrated two clusters of three skulls with first and second degree family relationships between the out of context cranial fragments, dating to the Late Etruscan period. Unsurprisingly, the different sampling strategy of Antonio et al., 2019, which was more substantially a population study, discovered no close kin relations between the small numbers of individuals sampled from each site. The work of Moots et al., 2023, Antonio et al., 2024, combined with more recent contributions (Bagnasco et al., 2024; Ravasini et al., 2024), has established that the first millennium BC was a period of relative genetic stability, where the majority of sequenced individuals have a broad Italian genetic affinity (Figure 14), whereas the remaining 10 have a wide range of genetic affinities from the Baltic, central Europe, Sardinia, North Africa, Greece and the Middle East. It would be dangerous extrapolate from these 32 the proportion of individuals with a more distant ancestry, but it does indicate that as many as c. 30% may have been more mobile ancestrally than the majority of the nucleated community.

Our recent work brought six of these individuals into consideration (Bagnasco et al., 2024), and we suggest that our detailed approach focused on precise archeological contexts is the way forward. Ghirotto et al. (2013, p. 1) claim that early Iron Age burials were entirely cremated. Even if most early Iron Age burials were indeed cremated, this is, in fact, not always the case and our recent study has taken advantage of this fact. These, unlike most of the other samples investigated have a very precise stratigraphic provenance, excavated under good modern conditions. Most importantly, they are inhumations with the precious petrous bone present, allowing multifaceted approach. We need to remain cautious about the implications of these results, because they formed part of a special place for burial that so far only consists of 20 inhumations from the main Etruscan phase of the city stretched over most of its chronological range, but concentrated in its early part, and thus may not be representative of the full nucleated community.

The six skeletons studied by our team have nevertheless permitted both a micro study and a macro study, with an interdependence between the two, assisted not just by ancient DNA on five but also by a range of other studies including palaeopathology, isotopes and radiocarbon dating on all six. The micro study shows that these are not closely related individuals, while the macro study indicates that at

least one had a distant ancestral origin from the Baltic and the isotopes seem to confirm a probable mobile life course for the same individual and a second. At a population level, all the new individuals, but? one with a broadly Baltic ancestry, cluster with other first millennium BC individuals of central Italy, suggesting a coherent interacting nucleated population, that fits neatly into the broader patterns established by Moots et al. (2023) and Antonio et al. (2024), and included in the generalized pattern.

5.3 From genetics and isotopes to levels of mobility

Isotope analysis on human remains, for reconstructing diet and mobility, have involved various Villanovan and Etruscan sites within and outside the main Etruscan territory of central Italy (e.g., Cangemi, 2016; Esposito et al., 2023; Bagnasco et al., 2024; Riccomi et al., 2024) and many other contexts are under analysis¹.

Strontium isotope ratio $^{87}\text{Sr}/^{86}\text{Sr}$ analysis of individuals from the necropolis of Quattro Fontanili of Veii (Cangemi, 2016) – one of the largest Etruscan settlements located on a plateau of 175 hectares – showed that between 15 and 20% of the analyzed individuals were non-local (Cangemi, 2016, p. 134). The site of Fermo (ninth-fifth century BC, Miranda and Esposito, 2021) exemplifies well the Villanovan expansion within the Italian peninsula (Miranda and Esposito, 2021; Miranda, 2022; Esposito, 2022; Pacciarelli, 2022). The site, located in the Marche region, is surrounded by typical Picene sites, characterized by different material cultures and funerary rituals (Naso, 2000; von Eles and Baldelli, 2017). $^{87}\text{Sr}/^{86}\text{Sr}$ isotope analysis by Esposito et al. (2023) showed the presence of 22.2% of non-local individuals. Archeological studies (Miranda, 2018; Esposito, 2022; Miranda, 2022; Miranda and Esposito, 2021) associated with osteological and isotope data (Esposito et al., 2023; Esposito, 2021; Esposito, 2023) have given more nuanced insight into patterns of human mobility at Fermo, limiting the idea of a cultural embodiment of Fermo by Picene groups. The presence of isotopically non-local individuals is indicated in the earliest phases of the necropolis (ninth-eighth century BC), whilst showing only isotopically local individuals in the latter phases (seventh-sixth century BC). The study of the six individuals buried in the sacred heart of Tarquinia demonstrated that two out of the six were isotopically non-local, a slightly higher percentage compared with the other sites. The general character of these specially buried individuals will be further clarified when comparing them with the other 14 inhumed skeletons buried at the monumental complex and the individuals from the vast majority of the community buried within the cemeteries surrounding the settlement.

By combining the current evidence from isotope analysis and aDNA, we can estimate a range of individual mobility from about 15/20% in some episodes of more distant communities to roughly 20% for the main body of a well-connected community, to levels of about 30% for more special individuals within a well-connected community. The term episode is key to this characterization, because future research needs not only to address larger samples, but also to

¹ <https://cordis.europa.eu/project/id/101065320>

provide greater archeological insight and chronological control within the biography of the city in order to be able to compare the different realities that contributed to the urbanization of the Etruscan world. The use of multiple proxies such as archeological context (i.e., funerary data, grave goods, chronology), osteological data, multi-isotope (e.g., $\delta^{15}\text{N}$, $\delta^{13}\text{C}$, $\delta^{34}\text{S}$, $\delta^{18}\text{O}$, $^{87}\text{Sr}/^{86}\text{Sr}$) multi-tissues (e.g., tooth enamel sampling, incremental dentine sampling, bone sampling) analyses and aDNA for the reconstruction of the osteobiography and past identity (Blake, 2025) of ancient individuals will contribute increasing level of scalar and contextual sophistication. These approaches have the potential to reveal detailed information on the life-history of the individual analyzed and possible shift in lifestyle, while giving back a broader dataset for comparison. The combination of all these data will produce a more nuanced understanding of the human past, analyzing past dynamics from the perspective of the single individual, the community and, more broadly, on the Etruscan group, providing past narratives of great interest.

6 Political control

Early accounts of Etruscan nucleation suggested a series of equally spaced peer polities (Renfrew, 1975; Figure 5), and indeed the notionally 12 major nucleated centers did share similar characteristics of highly nucleated primate organization. However, more recent detailed research has uncovered the fact that Etruscan cities varied in their political control of their countryside. This has been extensively reported elsewhere (Stoddart, 2020a; Zeviani, 2023) and so we only give some indicative examples here. This variation was partly geopolitical and partly environmental. The coastal territory of the city of Tarquinia had both a dendritic structure and a stepped hierarchy. On the coast, a ritualized port of trade mediated with the Mediterranean. In turn, the primate city of Tarquinia mediated with the secondary centers in the hinterland. The immediate environs of Tarquinia were the lower courses of the Marta river, and contained largely calcareous outcrops, whereas the secondary centers, such as Tuscania, were set in a volcanic terrain. Frontiers of such a territory were not absolute, but do seem to have some meaning, often marked by natural features or cultural markers such as sanctuaries. To the north the territory was indicated by the Arrone river and to the south by the very substantial Tolfa hills, also marked by ritual sites such as the Punta della Vipera sanctuary. The city territory of Cerveteri, immediately to the south, was almost entirely volcanic and substantially hedged in by Tarquinia to the north and the expansive city territory of Veii to the East. This city territory of Veii was perhaps the most expansive nucleated center, most probably incorporating the smaller centers of the culturally differentiated Faliscan territory to the north, until it was itself the first Etruscan city to be incorporated in the axis of Rome.

Strategies of nucleation according to the geopolitical location and environmental context were not always sufficient to sustain control and there is some evidence that violence was another approach. The 20 skeletons discovered in the *complesso monumentale* of the Civita of Tarquinia seem all to have suffered some form of maltreatment close to, or at, the time of death. The fact that material symbols of power (axe, trumpet and shield) were deliberately buried in the same location suggests that sanctions of violence were also applied, corroborated by Latin textual and Etruscan visual evidence.

7 Conclusion

In this review article we have sought to assess critically the current trends and opportunities of the study of nucleation in central Italy, focusing principally on the Etruscan Tyrrhenian flank of the peninsula, but necessarily setting the pattern within a wider context. It is potentially an exciting moment, when a comprehensive approach will bring these neglected data sets into wider exposure. For some time, scholars have achieved a powerful cultural history, one that has often been a concealed proxy for the Greek world, seen through the museum cases of the western world. We now potentially have more powerful proxies of the very people whose life courses created nucleation and whose bodily remains were placed in the cemeteries that mainly surrounded their nucleated habitations. We propose an approach that combines the stimulation of comparative ethnography with the bedrock of the life and earth sciences to take the field forward. The use of ethnography is rarely employed in the context of classical archeology, because the ancient writers provide their own ethnohistories. However, we think it useful here that in the spirit illustrated by Henry Wright (2006) and Flannery and Marcus (2012), we can stimulate the sense of difference of the Etruscan ethnography, guided away from exotic narratives by multi-faceted scientific data.

The current article seeks to provide some of the data that allow comparison with other societies in terms of how institutions are formed and developed over the course of time (cf. Carballo and Feinman, 2023, pp. 65–69). The approach emphasizes the variability of the experiment of nucleation within the constraints of interacting centers. The practice of territorial management was varied, determined by the geopolitical location, the level of interaction, the size of the managed territory and the ecology of the surrounding landscape. The general pattern was longevity and sustainability (cf. Feinman et al., 2023) that has been compared elsewhere to Monte Alban in the Valley of Oaxaca as a product of collective action (Stoddart, 2010), but this was not an absolutely consistent pattern. In contrast to many Mesoamerican examples outside the Maya area, the overall landscape took the form of competing peer polities that survived together, until the system was interrupted by Rome. The seventh century BC was most probably a tipping point when the descent group, the institutional strategies of the first stages of nucleation, were replaced by more community-based strategies, albeit still tempered by the enduring importance of the self-same descent groups.

Author contributions

SS: Conceptualization, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. EB: Investigation, Writing – review & editing. CE: Investigation, Writing – original draft, Writing – review & editing. GM: Investigation, Writing – original draft. FG: Investigation, Writing – review & editing. RM: Investigation, Writing – review & editing. LM: Investigation, Supervision, Writing – review & editing. OP: Investigation, Writing – review & editing. FS: Investigation, Writing – review & editing. CZ: Investigation, Writing – original draft.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. CE is supported by the European Union's Horizon Europe Research and Innovation programme under the Marie Skłodowska-Curie Actions PF (GA no.101065320 — TULAR).

Simon Stoddart would like to thank the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project-ID 290391021 – SFB 1266 for intellectual partnership with the University of Kiel during the writing of this article. Camilla Zeviani would like to thank the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project-ID 290391021 – SFB 1266 for funding at the University of Kiel during the writing of this article. Many of the original data were procured with funding provided by a Humanities and Social Sciences International strategy award of the University of Cambridge.

Acknowledgments

We would like to thank Angela Trentacoste for her generous comments on this article.

References

- Achilli, A., Olivieri, A., Pala, M., Metspalu, E., Fornarino, S., Battaglia, V., et al. (2007). Mitochondrial DNA variation of modern Tuscans supports the near eastern origin of Etruscans. *Am. J. Hum. Genet.* 80, 759–768. doi: 10.1086/512822
- Alvarez, W. (1972). The treia valley north of Rome: volcanic stratigraphy, topographic evolution and geographical influence on human settlement. *Geol. Rom.* 11, 153–176.
- Amann, P. (2024). “The Etruscans – a Society of Masters and Servants? A modern Topos and its origins” in *Dependency and social inequality in pre-Roman Italy*. eds. M. Bentz and P. Zeidler (Berlin: De Gruyter), 15–47.
- Antonio, M. L., Gao, Z., Moots, H. M., Lucci, M., Candilio, F., Sawyer, S., et al. (2019). Ancient Rome: a genetic crossroads of Europe and the Mediterranean. *Science* 366, 708–714. doi: 10.1126/science.aay6826
- Antonio, M. L., Weiß, C. L., Gao, Z., Sawyer, S., Oberreiter, V., Moots, H. M., et al. (2024). Stable population structure in Europe since the Iron age, despite high mobility. *eLife* 13:e79714. doi: 10.7554/eLife.79714
- Bagnasco, G., Bortolotto, S., and Magli, G. (2013). Astronomy and Etruscan ritual: the case of the Ara della Regina in Tarquinia. *Nexus Netw. J.* 15, 445–455. doi: 10.1007/s00004-013-0163-7
- Bagnasco, G., Marzullo, M., Cattaneo, C., Biehler-Gomez, L., Mazzarelli, D., Ricciardi, V., et al. (2024). Bioarchaeology aids the cultural understanding of six characters in search of their agency (Tarquinia, ninth–seventh century BC, Central Italy). *Sci. Rep.* 14:11895. doi: 10.1038/s41598-024-61052-z
- Barbaro, B. (2010). *Inseguimenti, aree funerarie ed entità territoriali in Etruria meridionale nel Bronzo Finale*. Firenze: All'Insegna del Giglio.
- Barker, G. (1981). *Landscape and society: Prehistoric Central Italy*. London: Academic Press.
- Barker, G., Rasmussen, T., Brown, T., Ellis, C., and Rhodes, E. (2023). “The natural landscape and its evolution” in *In the footsteps of the Etruscans: Changing landscapes around Tuscania from prehistory to modernity*. eds. G. Barker and T. Rasmussen (Cambridge: Cambridge University Press), 61–84.
- Becker, H. (2008). “The economic agency of the Etruscan temple: elites, dedications and display” in *Votives, places and rituals in Etruscan religion: Studies in honor of Jean MacIntosh Turfa*. eds. M. Gleba and H. Becker (Boston: BRILL), 85–99.
- Bergamini, M. (Ed.) (1991). *Gli Etruschi maestri di idraulica*. Perugia: Electa editori Umbri.
- Betsinger, T. K., and DeWitte, S. N. (2020). *The bioarchaeology of urbanization: The biological, demographic, and social consequences of living in cities*. Cham: Springer International Publishing.
- Bizzarri, M. (1962). La necropoli di Crocefisso del Tufo I. *Studi Etruschi* 30, 136–151.
- Bizzarri, M. (1966). La necropoli di Crocefisso del Tufo II. *Stud. Etruschi* 34, 3–108.
- Blake, E. (2025). *Identity studies in archaeology*. Cambridge: Cambridge University Press.
- Blanton, R. E., and Fargher, L. (2008). *Collective action in the formation of pre-modern states*. New York, NY: Springer.
- Bogaard, A., Styring, A., Whitlam, J., Fochesato, M., and Bowles, S. (2018). “Farming, inequality, and urbanization a comparative analysis of late prehistoric northern Mesopotamia and southwestern Germany” in *Ten thousand years of inequality: The archaeology of wealth differences*. eds. T. A. Kohler and M. E. Smith (Tucson: University of Arizona Press), 201–229.
- Boissevain, J. (1964). Factions, parties and politics in a Maltese village. *Am. Anthropol.* 66, 1275–1287. doi: 10.1525/aa.1964.66.6.02a00030
- Boissevain, J. (1979). Network analysis: a reappraisal. *Curr. Anthropol.* 20, 392–394. doi: 10.1086/202277
- Boissevain, J. (2011). Further thoughts on networks and the Mediterranean. *J. Mediterr. Stud.* 20, 53–64.
- Boissevain, J. (2013). *Factions, friends and feasts: Anthropological perspectives on the Mediterranean*. New York, NY: Berghahn Books.
- Bonghi Jovino, M. (2010). The Tarquinia project: a summary of 25 years of excavation. *Am. J. Archaeol.* 114, 161–180. doi: 10.3764/aja.114.1.161
- Brandt, J. R., and Karlsson, L. (Eds.) (2001). “From huts to houses. Transformations of ancient societies” in *Proceedings of an international seminar organised by the Norwegian and Swedish Institutes in Rome, 21–24 September 1997* (Stockholm: Paul Åströms Förlag).
- Briquel, D. (2000). Le origini degli Etruschi: una questione dibattuta fin dall'Antichità. In M. Torelli (ed.) *Gli Etruschi. Catalogue of the Venice exhibition*. Venice: Bompiani, 45–51.
- Brock, A., Marra, F., Motta, L., Nicosia, and Terrenato, N. (2025). Natural and anthropic influences on the transformation of the landscape in archaic Rome. *J. Archaeol. Sci. Rep.* 62:105055. doi: 10.1016/j.jasrep.2025.105055
- Brock, A., Motta, L., and Terrenato, N. (2021). On the banks of the Tiber: opportunity and transformation in early Rome. *J. Roman. Stud.* 111, 1–30. doi: 10.1017/S0075435821000344
- Brönnimann, D., Röder, B., Spichtig, N., Rissanen, H., Lassau, G., and Rentzel, P. (2020). The hidden midden: geoarchaeological investigation of sedimentation processes, waste disposal practices, and resource management at the La Tène settlement of Basel-Gasfabrik (Switzerland). *Geoarchaeology* 35, 522–544. doi: 10.1002/gea.21787
- Brown, A. G., and Ellis, C. (1995). People, climate and alluviation: theory, research design and new sedimentological and stratigraphic data from Etruria. *Pap. Br. Sch. Rome* 63, 45–73. doi: 10.1017/S0068246200010199
- Bruder, S. K. (2022). *Man lebt, wie man wohnt: Untersuchungen zur Wohnhausarchitektur Mittel- und Norditaliens vom ausgehenden 6. bis zum beginnenden 2. Jh. v. Chr.* Heidelberg: Universität Propyläeum – Fachinformationsdienst Altertumswissenschaften.
- Buonincontri, M., Allevato, E., and Di Pasquale, G. (2013). The problem of the alternating dominance of deciduous and evergreen vegetation: archaeo-anthropological data from northern Maremma. *Ann. Bot.* 3, 165–171. doi: 10.4462/annbotm-10269
- Butzer, K. W. (2005). Environmental history in the Mediterranean world: cross-disciplinary investigation of cause-and-effect for degradation and soil erosion. *J. Archaeol. Sci.* 32, 1773–1800. doi: 10.1016/j.jas.2005.06.001
- Cangemi, I. (2016). *A scale-free, relational approach to social development in late prehistoric Tyrrhenian central Italy*. Ann Arbor: Unpublished Phd, University of Michigan.
- Cappellini, E., Biella, M. C., Chiarelli, B., and Caramelli, D. (2003). Lo studio del DNA antico: il caso della tb 5859 della necropoli dei Monterozzi di Tarquinia. *Stud. Etrusch.* 69, 263–275.
- Cappellini, E., Chiarelli, B., Sineo, L., Casoli, A., Di Gioia, A., Vernesi, C., et al. (2004). Biomolecular study of the human remains from tomb 5859 in the Etruscan necropolis of Monterozzi, Tarquinia (Viterbo, Italy). *J. Archaeol. Sci.* 31, 603–612. doi: 10.1016/j.jas.2003.10.012

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Carballo, D. M., and Feinman, G. M. (2023). *Collective action and the reframing of early Mesoamerica*. Cambridge: Cambridge University Press.
- Cardarelli, A. (2009). The collapse of the Terramare culture and growth of new economic and social systems during the late bronze age in Italy. *Storia Archeol. Antropol.* 15, 449–520.
- Cardosa, M., and Pitone, M. R. (2012). Quotidianità del rito e ritualità del quotidiano a Sorgenti della Nova. In N. Negroni Catacchio (ed). *Atti del Decimo Incontro di Studi Preistoria e Protostoria in Etruria – L'Etruria dal Paleolitico al Primo Ferro. Lo stato delle ricerche* (Valentano – Pitigliano 10–12 settembre 2010). Milan: Centro Studi di Preistoria e Archeologia – Onlus, 597–617.
- Cavazzuti, C., and Putzolo, C. (2015). “Strategie di occupazione dell'appennino emiliano durante l'età del bronzo” in I pascoli, i campi, il mare, Paesaggi d'altura e di pianura in Italia dall'Età del Bronzo al Medioevo. eds. F. Cambi, G. De Venuto and R. Goffredo (Bari: Edipuglia), 51–71.
- Ceballos, F. C., Joshi, P. K., Clark, D. W., Ramsay, M., and Wilson, J. F. (2018). Runs of homozygosity: windows into population history and trait architecture. *Nat. Rev. Genet.* 19, 220–234. doi: 10.1038/nrg.2017.109
- Cecconi, F., di Gennaro, F., Parisi, D., and Schiappelli, A. (2015). “Simulating the emergence of proto-urban centres in ancient southern Etruria” in *Mathematics and archaeology*. eds. J. A. Barcelo and I. Bogdanovic (Boca Raton: CRC Press), 449–462.
- Cerveteri, E. F. (1993). *Ricognizioni archeologiche nel territorio di una città etrusca*. Roma: Gruppo Archeologico Romano.
- Chapman, J., Videiko, M., Hale, D., Gaydarska, B., Burdo, N., Rassmann, K., et al. (2014). The second phase of the Trypillia mega-site methodological revolution: a new research agenda. *Eur. J. Archaeol.* 17, 369–406. doi: 10.1179/1461957114Y.0000000062
- Cherkauer, D. S. (1976). “Site K. The stratigraphy and chronology of the river Treia alluvial deposits” in *A faliscan town in south Etruria. Excavations at Narce 1966–71*. ed. T. W. Potter (London: The British School at Rome), 106–126.
- Clarke, D. L. (1972). “A provisional model of an Iron age society and its settlement system” in *Models in archaeology*. ed. D. L. Clarke (London: Methuen), 801–869.
- Coradeschi, G., Beltrame, M., Rafanelli, S., Quaratesi, C., Sadori, L., and Barrocas Dias, C. (2021). The wooden roof framing elements, furniture and furnishing of the Etruscan Domus of the Dolia of Vetulonia (southern Tuscany, Italy). *Heritage* 4, 1938–1961. doi: 10.3390/heritage4030110
- Cornell, T. J. (1976). Etruscan historiography. *Ann. Sc. Norm. Super. Pisa. Cl. Lett. Filos.* 6, 411–439.
- D'Orefice, M., Bellotti, P., Bellotti, T., Davoli, L., and Di Bella, L. (2022). Natural and cultural lost landscape during the Holocene along the central Tyrrhenian coast (Italy). *Land* 11:344. doi: 10.3390/land11030344
- De Grossi Mazzorin, J. (2001). “Archaeozoology and habitation models: from a subsistence to a productive economy in Central Italy” in *From huts to houses. Transformations of ancient societies*. eds. J. R. Brandt and L. Karlsson, Proceedings of an International Seminar organised by the Norwegian and Swedish Institutes in Rome, 21–24 September, vol. 1997 (Paul Åströms Förlag: Stockholm), 323–330.
- De Grossi Mazzorin, J., and Minniti, C. (2023). The impact of trade on animal exploitation in Rome during the Roman period: the evidence from zooarchaeological analysis. *J. Archaeol. Sci. Rep.* 47:103725. doi: 10.1016/j.jasrep.2022.103725
- de Haas, T. (2017). Managing the marshes: an integrated study of the centuriated landscape of the pontine plain. *J. Archaeol. Sci. Rep.* 15, 470–481. doi: 10.1016/j.jasrep.2016.07.012
- DeMarrais, E. (2016). Making pacts and cooperative acts: the archaeology of coalition and consensus. *World Archaeol.* 48, 1–13. doi: 10.1080/00438243.2016.1140591
- DeMarrais, E., and Earle, T. (2017). Collective action theory and the dynamics of complex societies. *Ann. Rev. Anthropol.* 46, 183–201. doi: 10.1146/annurev-anthro-102116-041409
- di Gennaro, F. (1986). *Forme di insediamento tra Tevere e Fiora dal Bronzo Finale al principio dell'età del ferro*. Firenze: Olschki.
- di Gennaro, F. (2000). ““Paesaggi di potere”: l'Etruria meridionale in età protostorica” in *Paesaggi di potere: problemi e prospettive: atti del Seminario*, Udine, 16–17 maggio 1996. eds. G. Camassa, A. De Guio and F. Veronese (Quasar: Roma), 95–119.
- di Gennaro, F., Amoroso, A., and Schiappelli, A. (2004). “Un confronto tra gli organismi prototatili delle due sponde del Tevere. Le prime fasi di Veio e di Crustumero” in *Bridging the Tiber: Approaches to regional archaeology in the middle Tiber Valley*. ed. H. Patterson (London: British School at Rome), 147–178.
- Di Pasquale, G. (2003). “I carboni di Chiusi: una ipotesi di ricostruzione del paesaggio forestale” in *Manifattura ceramica etrusco-romana a Chiusi. Il complesso produttivo di Marciannella*. eds. G. Pucci and C. Mascione (Bibari, Edipuglia srl, Bari), 315–320.
- Dodd, E. (2022). The archaeology of wine production in Roman and pre-Roman Italy. *Am. J. Archaeol.* 126, 443–480. doi: 10.1086/719697
- Drescher-Schneider, R., de, J. L., Magny, M., Walter-Simonnet, A., Bossuet, G., Millet, L., et al. (2007). Vegetation history, climate and human impact over the last 15,000 years at Lago dell'Accesa (Tuscany, Central Italy). *Veget. Hist. Archaeobot.* 16, 279–299. doi: 10.1007/s00334-006-0089-z
- Enei, F. (2001). *Progetto Ager Caerentanus. Il litorale di Alsium*. (Ricognizioni archeologiche nel territorio di Ladispoli, Cerveteri e Fiumicino). Ladispoli: Comune di Ladispoli - Regione Lazio.
- Esposito, C. (2021). *Population dynamics in first millennium BCE Italy: Mobility and ancestry at Fermo, Marche*. Belfast: Unpublished PhD Dissertation, Queen's University Belfast.
- Esposito, C. (2022). “Fermo villanoviana: le prime fasi della necropoli dal IX al VII sec. a.C. Archeologia Picena” in *Atti del convegno internazionale di studi*. Ancona 14–16.11. 2019. eds. N. Frapiccinini and A. Naso (Quasar: Roma), 141–155.
- Esposito, C. (2023). Rome fellowships: TULAR: human mobility and social-cultural shifts in frontier areas of pre-Roman Italy. *Pap. Br. Sch. Rome* 91, 353–354. doi: 10.1017/S0068246223000235
- Esposito, C., Gigante, M., Lugli, F., Miranda, P., Cavazzuti, C., Sperduti, A., et al. (2023). Intense community dynamics in the pre-Roman frontier site of Fermo (ninth–fifth century BCE, Marche, Central Italy) inferred from isotopic data. *Sci. Rep.* 13:3632. doi: 10.1038/s41598-023-29466-3
- Feinman, G. M., and Carballo, D. M. (2018). Collaborative and competitive strategies in the variability and resiliency of large-scale societies in Mesoamerica. *Econ. Anthropol.* 5, 7–19. doi: 10.1002/sea2.12098
- Feinman, G. M., Carballo, D. M., Nicholas, L. M., and Kowalewski, S. A. (2023). Sustainability and duration of early central places in prehispanic Mesoamerica. *Front. Ecol. Evol.* 11:1076740. doi: 10.3389/fevo.2023
- Finné, M., Woodbridge, J., Labuhn, I., and Roberts, C. N. (2019). Holocene hydro-climatic variability in the Mediterranean: a synthetic multi-proxy reconstruction. *The Holocene* 29, 847–863. doi: 10.1177/0959683619826634
- Flannery, K. V. (Ed.) (1976). *The early mesoamerican village*. New Mexico: Academic Press.
- Flannery, K. V., and Marcus, J. (1983). *The cloud people*. New York: Academic Press.
- Flannery, K. V., and Marcus, J. (2012). *The creation of inequality: How our prehistoric ancestors set the stage for monarchy, slavery, and empire*. Cambridge: Harvard University Press.
- Fuchs, M. (2007). An assessment of human versus climatic impacts on Holocene soil erosion in NE Peloponnese, Greece. *Quat. Res.* 67, 349–356. doi: 10.1016/j.yqres.2006.11.008
- Fuller, D. Q., and Stevens, C. J. (2019). Between domestication and civilization: the role of agriculture and arboriculture in the emergence of the first urban societies. *Veg. Hist. Archaeobotany* 28, 263–282. doi: 10.1007/s00334-019-00727-4
- Fernandes, D. M., Mittnik, A., Olalde, I., Lazaridis, I., Cheronet, O., Rohland, N., et al. (2020). The spread of steppe and Iranian-related ancestry in the islands of the western Mediterranean. *Nature Ecology and Evolution* 4: 334–45.
- Fox, S., and Wolf, L. J. (2024). People make places urban. *Nature Cities* 1: 813–20.
- Garton Ash, T. (2023). *Homelands: A personal history of Europe*. London: The Bodley Head.
- Gavériaux, F., Motta, L., Bailey, P., Brilli, M., and Sadori, L. (2024). Crop husbandry at Gabii during the iron age and archaic period: the archaeobotanical and stable isotope evidence. *Environ. Archaeol.* 29, 370–383. doi: 10.1080/14614103.2022.2101281
- Ghirotto, S., Tassi, F., Fumagalli, E., Colonna, V., Sandionigi, A., Lari, M., et al. (2013). Origins and evolution of the Etruscans' mtDNA. *PLoS One* 8:e55519. doi: 10.1371/journal.pone.0055519
- Gilman, A. (1981). The development of social stratification in bronze age Europe. *Curr. Anthropol.* 22, 1–22. doi: 10.1086/202600
- Ginzburg, C. (1993). Microhistory: two or three things that I know about it. *Crit. Inq.* 20, 10–35. doi: 10.1086/448699
- Guidi, A. (1989). “Alcune osservazioni sull'origine delle città etrusche” in *Atti del Secondo Congresso Internazionale Etrusco*. Firenze 26 maggio - 2 giugno, 1985. eds. G. Maetke, M. G. Marzi Costagli, M. Iozzo, O. Paoletti and E. J. Shepherd (Roma: Giorgio Bretschneider Editore), 285–292.
- Haughton, M., and Løvschal, M. (2023). Ancestral commons: the deep-time emergence of bronze age pastoral mobility. *Antiquity* 97, 1–18. doi: 10.15184/aqy.2023.154
- Helms, M. W. (2007). “House life” in *The durable house: House society models in archaeology*. ed. R. A. Beck (Carbondale, IL: Center for Archaeological Investigations, Southern Illinois University), 487–504.
- Holland-Lulewicz, J., Conger, M. A., Birch, J., Kowalewski, S. A., and Jones, T. W. (2020). An institutional approach for archaeology. *J. Anthropol. Archaeol.* 58:101163. doi: 10.1016/j.jaa.2020.101163
- Hunt, C. O. (1995). “The natural landscape and its evolution” in *A mediterranean valley: Landscape archaeology and annales history in the Biferno Valley*. ed. G. Barker (Leicester: Leicester University Press), 62–83.
- Jannot, J.-R. (2005). *Religion in ancient Etruria*. Madison: University of Wisconsin Press.
- Judson, S. (1963). Erosion and deposition of Italian stream valleys during historic time. *Science* 140, 898–899. doi: 10.1126/science.140.3569.898
- Judson, S. (1968). Erosion rates near Rome, Italy. *Science* 160, 1444–1446. doi: 10.1126/science.160.3835.1444
- Judson, S., and Kahane, A. (1963). Underground drainageways in southern Etruria and northern Latium. *Pap. Br. Sch. Rome* 31, 74–99. doi: 10.1017/S0068246200001677

- Kanne, K., Haughton, M., and Lash, R. (2024). Common animals: sedentary pastoralism and the emergence of the commons as an institution. *Front. Human Dynam.* 6. doi: 10.3389/fhumd.2024.1389009
- Karkanas, P., and Van De Moortel, A. (2014). Micromorphological analysis of sediments at the bronze age site of Mitrou, Central Greece: patterns of floor construction and maintenance. *J. Archaeol. Sci.* 43, 198–213. doi: 10.1016/j.jas.2014.01.007
- Kopytoff, I. (Ed.) (1989). *The african frontier: The reproduction of traditional African societies*. Bloomington: Indiana University Press.
- Lippi, M., Giachi, G., Paci, S., and di, P. (2000). Studi sulla vegetazione attuale e passata della Toscana meridionale (Follonica - Italia) e considerazioni sull'impatto ambientale dell'attività metallurgica etrusca nel VI-V secolo a.C. *Webbia* 55, 279–295. doi: 10.1080/00837792.2000.10670696
- MacCormack, S. (2007). *On the wings of time Rome, the Incas, Spain, and Peru*. Princeton: Princeton University Press.
- Malone, C., and Stoddart, S. (1994). "The meaning and function of the middens on Monte Ingino and Monte Ansciano" in *Territory, time and state. The archaeological development of the Gubbio basin*. eds. C. Malone and S. Stoddart (Cambridge: Cambridge University Press), 119–127.
- Malone, C., Stoddart, S., Ceccarelli, L., Cencioli, L., Duff, P., McCormick, F., et al. (2014). "Beyond feasting: consumption and life style amongst the invisible Etruscans" in *Living in the landscape. Essays in honour of Graeme Barker*. eds. K. Boyle, R. Rabett and C. Hunt (Cambridge: McDonald Institute), 257–266.
- Malyarchuk, B. A., and Rogozin, I. B. (2004). On the etruscan mitochondrial DNA contribution to modern humans. *Am. J. Hum. Genet.* 75, 920–923. doi: 10.1086/425220
- Marchesini, S. (2007). *Prosopographia Etrusca II, 1: Studia: Gentium Mobilitas*. Roma: L'Erma di Bretschneider.
- Mariotti Lippi, M., Mori Secci, M., Giachi, G., Bouby, L., Terral, J. F., Castiglioni, E., et al. (2020). Plant remains in an Etruscan-Roman well at Cetamura del chianti, Italy. *Archaeol. Anthropol. Sci.* 12. doi: 10.1007/s12520-019-00992-4
- Michetti, L. M. (2013). "Riti e miti di fondazione nell'Italia antica. Riflessioni su alcuni contesti di area etrusca" in *Mura di legno, mura di terra, mura di pietra: fortificazioni nel Mediterraneo antico*, Atti Convegno Internazionale (Roma 2012). eds. G. Bartoloni and L. M. Michetti, Scienze delle Antichità 19 (2–3) (Rome: Edizioni Quasar), 333–357.
- Miller, P. M. (2017). *Continuity and change in Etruscan domestic architecture*. Oxford: Archaeopress Publishing Ltd.
- Min, L. (2019). "Why early cities failed: fragility and resilience in bronze age China" in *The evolution of fragility: Setting the terms*. ed. N. Yoffee (Cambridge: McDonald Institute), 25–45.
- Minniti, C. A. (2012). *Sussistenza e articolazione sociale nell'Italia Centrale tra Bronzo Medio e Primo Ferro* (British Archaeological Reports International Series 2394). Oxford: Archaeopress.
- Miranda, P. (2018). *Fermo (FM). La necropoli di c. da Mossa*. Naples: Unpublished PhD Dissertation, Università degli Studi di Napoli Federico II.
- Miranda, P. (2022). "Gli esiti culturali di Fermo villanoviana dai decenni centrali dell'VIII al VI sec. a.C." in *Atti del convegno internazionale di studi*. Ancona 14–16.11. 2019. eds. N. Frapiccinini and A. Naso (Roma: Quasar), 157–167.
- Miranda, P., and Esposito, C. (2021). Sulla periodizzazione delle necropoli protostoriche di Fermo. *Mitt. Dtsch. Archäol. Inst. Röm. Abt.* 127, 63–109. doi: 10.34780/7gdb-fbu2
- Modi, A., Lancioni, H., Cardinali, I., Capodiferro, M. R., Rambaldi Migliore, N., Hussein, A., et al. (2020). The mitogenome portrait of Umbria in Central Italy as depicted by contemporary inhabitants and pre-Roman remains. *Sci. Rep.* 10:10700. doi: 10.1038/s41598-020-67445-0
- Moots, H. M., Antonio, M., Sawyer, S., Spence, J. P., Oberreiter, V., Weiß, C. L., et al. (2023). A genetic history of continuity and mobility in the Iron age Central Mediterranean. *Nat. Ecol. Evol.* 7, 1515–1524. doi: 10.1038/s41559-023-02143-4
- Moses, V. C. (2020). *The zooarchaeology of early Rome: Meat production, distribution, and consumption in public and private spaces 9th-5th centuries BCE*. The University of Arizona: Unpublished PhD Dissertation.
- Motta, L., and Beydler, K. (2021). "Iron age Italy" in *Companion to ancient agriculture*. eds. D. Hollander and T. Howe (Hoboken, New Jersey: Wiley Blackwell), 399–415. doi: 10.1002/9781118970959.ch19
- Muse, K. (2007). Sergestus and Tarchon in the Aeneid. *Class. Q.* 57, 586–605. doi: 10.1017/S0009838807000572
- Nalls, M. A., Simon-Sanchez, J., Gibbs, J. R., Paisan-Ruiz, C., Bras, J. T., Tanaka, T., et al. (2009). Measures of autozygosity in decline: globalization, urbanization, and its implications for medical genetics. *PLoS Genet.* 5:e1000415. doi: 10.1371/journal.pgen.1000415
- Naso, A. (2000). *I piceni. Storia e archeologia delle Marche in epoca preromana*. Milano: Longanesi.
- Nicosia, C., Polisca, F., Miller, C., Ligouis, B., Mentzer, S., Mangani, C., et al. (2022). High-resolution sediment analysis reveals middle bronze age byre-houses at the site of Oppeano (Verona province, NE Italy). *PLoS One* 17:e0272561. doi: 10.1371/journal.pone.0272561
- Nielson, K. P. (1984). Tarchon Etruscus: alter aeneas. *Pac. Coast Philol.* 19, 28–34. doi: 10.2307/1316578
- Pacciarelli, M. (2000). "Dal villaggio alla città: la svolta protourbana del 1000 a.C. nell'Italia tirrenica" in *Grandi contesti e problemi della protostoria italiana* (Firenze: All'insegna del Giglio).
- Pacciarelli, M. (2017). "The transition from village communities to protourban societies" in *Etruscology*. eds. A. Naso and A. Naso (Berlin: De Gruyter), 561–580.
- Pacciarelli, M. (2022). "Il progetto di studio delle necropoli protostoriche di Fermo. Inquadramento e primo resoconto" in *Archeologia Picena. Atti del convegno internazionale di studi*. Ancona 14–16.11. 2019. eds. N. Frapiccinini and A. Naso (Roma: Quasar), 125–140.
- Pallottino, M. (1975). *The Etruscans*. London: Allen Lane.
- Parkinson, W. A., and Galaty, M. L. (2007). Secondary states in perspective: an integrated approach to state formation in the prehistoric Aegean. *Am. Anthropol.* 109, 113–129. doi: 10.1525/aa.2007.109.1.113
- Parkinson, E. W., McLaughlin, T. R., Esposito, C., Stoddart, S., and Malone, C. (2021). Radiocarbon dated trends and Central Mediterranean prehistory. *J. World Prehist.* 34, 317–379. doi: 10.1007/s10963-021-09158-4
- Parkinson, E. W., Stoddart, S., Sparacello, V., Bertoldi, F., Fonzo, O., Malone, C., et al. (2023). 30,000 years of multiproxy bioarchaeological data reveals interplay between growth, diet and population dynamics across the transition to farming in the Central Mediterranean. *Sci. Rep.* 13:2023. doi: 10.1038/s41598-023-49406-5
- Pellecchia, M., Negrini, R., Colli, L., Patrini, M., Milanese, E., Achilli, A., et al. (2007). The mystery of Etruscan origin: novel clues from Bos taurus mitochondrial DNA. *Proc. R. Soc. Lond. B Biol. Sci.* 274, 1175–1179. doi: 10.1098/rspb.2006.0258
- Perkins, P. (2012). "Production and commercialization of Etruscan wine in the Albegna Valley" in *Archeologia della vite e del vino in Toscana e nel Lazio. dalle tecniche dell'indagine archeologica alle prospettive della biologia molecolare*. eds. A. Zifferero, A. Ciacci and P. Rendini (Florence: All'insegna del Giglio), 413–416.
- Posth, C., Zaro, V., Spyrou, M. A., Vai, S., Gnechchi-Ruscione, G. A., Modi, A., et al. (2021). The origin and legacy of the Etruscans through a 2000-year archeogenomic time transect. *Sci. Adv.* 7:eabi7673. doi: 10.1126/sciadv.abi7673
- Puglisi, S. M. (1959). *La Civiltà appenninica. Origine delle comunità pastorali in Italia*. Firenze: Sansoni.
- Petrie, C. (2019). Diversity, variability, adaptation and 'fragility' in the Indus Civilization. In *The Evolution of Fragility: Setting the Terms* (ed. N. Yoffee (Cambridge: McDonald Institute), 109–34.
- Ravasi, E., Kabral, H., Solnik, A., de Gennaro, L., Montinaro, F., Hui, R., et al. (2024). The genomic portrait of the Picene culture provides new insights into the italic Iron age and the legacy of the Roman empire in Central Italy. *Genome Biol.* 25:292. doi: 10.1186/s13059-024-03430-4
- Rendeli, M. (1991). Sulla nascita delle comunità urbane in Etruria meridionale. *AION Ann. Archeol. Stor. Antica* 13, 9–45.
- Renfrew, A. C. (1975). "Trade as action at a distance: questions of interaction and communication" in *Ancient Civilisations and trade*. eds. J. A. Sabloff and C. C. Lamberg-Karlovsky (Albuquerque: School of American Research - University of New Mexico), 3–59.
- Riccomi, G., Simonit, R., Maudet, S., Scott, E., Lucas, M., Giuffra, V., et al. (2024). Diets, stress, and disease in the Etruscan society: isotope analysis and infantile skeletal palaeopathology from Pontecagnano (Campania, southern Italy, 730–580 BCE). *PLoS One* 19:e0302334. doi: 10.1371/journal.pone.0302334
- Russ, H., and Trentacoste, A. (2021). Wild food in an urban environment: freshwater fish consumption in the archaic town of Forcello (northern Italy). *Anthropozoologica* 56, 71–85. doi: 10.5252/anthropozoologica2021v56a5
- Robertshaw, P. (2019). Fragile States in Sub-Saharan Africa. In *The Evolution of Fragility: Setting the Terms*. (eds. N. Yoffee (Cambridge: McDonald Institute), 135–60.
- Sadori, L., Mercuri, A. M., and Mariotti, M. (2010). Reconstructing past cultural landscape and human impact using pollen and plant macroremains. *Plant Biosyst.* 144, 940–951. doi: 10.1080/11263504.2010.491982
- Samuels, T., Cohen, S., Johnson, T., Moses, V., Naglak, M., Opitz, R., et al. (2021). Reimagining urban success: rhythms of activity at Gabii, Italy, 800 BC – AD 600. *Antiquity* 96, 103–122. doi: 10.15184/aqy.2021.154
- Scheeres, M., Knipper, C., Hauschild, M., Schönfelder, M., Siebel, W., Vitali, D., et al. (2013). Evidence for "Celtic migrations"? Strontium isotope analysis at the early La Tène (LT B) cemeteries of Nebringen (Germany) and Monte Bibele (Italy). *J. Archaeol. Sci.* 40, 3614–3625. doi: 10.1016/j.jas.2013.05.003
- Setti, B., and Zanini, A. (1998). L'acropoli A delle Sparne nella protostoria. *Riv. Sci. Preist.* 49:499–522.
- Shriver-Rice, M., Mercuri, A. M., Trentacoste, A., Florenzano, A., and Stoddart, S. (2025). "Environmental approaches to Etruscan studies. Revisiting Negri 1927 almost one hundred years later" in *A new Etruscan archaeology*. ed. M. Forte (New York: Oxford University Press), 172–200.
- Shriver-Rice, M., and Schmidt, F. (2022). Environmental and archaeobotanical studies in Etruscan archaeology: an epistemological overview and future considerations of human-plant relationships. *Etrusc. Ital. Stud.* 25, 113–147. doi: 10.1515/etst-2022-0001

- Smith, M. L. (2008). Urban empty spaces. Contentious places for consensus-building. *Archaeol. Dialog.* 15, 216–231. doi: 10.1017/S1380203808002687
- Smith, M. E. (2010). The archaeological study of neighborhoods and districts in ancient cities. *J. Anthropol. Archaeol.* 29, 137–154. doi: 10.1016/j.jaa.2010.01.001
- Smith, M. E., Lobo, J., Peebles, M. A., York, A. M., Stanley, B. W., Crawford, K. A., et al. (2021). The persistence of ancient settlements and urban sustainability. *Proc. Natl. Acad. Sci.* 118:e2018155118. doi: 10.1073/pnas.2018155118
- Sparacello, V. S., Vercellotti, G., d'Ercole, V., and Coppa, A. (2017). Social reorganization and biological change: an examination of stature variation among Iron age Samnites from Abruzzo, Central Italy. *Int. J. Paleopathol.* 18, 9–20. doi: 10.1016/j.jipp.2017.07.003
- Saupe, T., Montinaro, F., Scaggion, C., Carrara, N., Kivisild, T., D'Atanasio, E., et al. (2021). Ancient genomes reveal structural shifts after the arrival of Steppe-related ancestry in the Italian Peninsula. *Curr Biol* 31: 2576–91.e12.
- Schmidt, F. (2025). *Feeding the Etruscans. (Cambridge: Unpublished PhD thesis).*
- Stoddart, S. (2000). "Introduction" in *Landscapes from antiquity*, ed. S. Stoddart (Cambridge: Antiquity Publications Limited), 1–5.
- Stoddart, S. (2014). A view from the south (west). Identity in Tyrrhenian Central Italy. In *Fingerprinting the Iron Age. Approaches to identity in the European Iron Age. Integrating South Eastern Europe into the Debate*. C. N. Popa and S. Stoddart (eds.), Oxford: Oxbow, 266–82.
- Stoddart, S. (2017a). *Delicate urbanism in context: the case of pre-Roman German urbanism.* (Cambridge: McDonald Institute).
- Stoddart, S. (2017b). The Apparent Invisibility of the Non-Elite and Rural Settlement North of the Tiber in the Age of Tarquin. In Smith, C. J. & Lulof, P. S. (eds.), *The Age of Tarquinius Superbus: Central Italy in the Late 6th Century. Proceedings of the Conference "The Age of Tarquinius Superbus, A Paradigm Shift?" Rome, 7-9 November 2013.* (Babesch Supplements 29). (Leuven: Peeters Publishers), 187–94.
- Stoddart, S. (2020a). *Power and Place in Etruria. The spatial dynamics of a Mediterranean civilisation. 1200-500 B.C.* (Cambridge: Cambridge University Press).
- Stoddart, S. (2020b). An Etruscan Urban agenda: the weaving together of traditions. *Journal of Urban Archaeology* 1: 88–121.
- Stoddart, S. (2022a). From the axial age to the fifth sun. the articulation of the local with the global. *Archaeol. Dialogues* 29, 18–21. doi: 10.1017/S1380203822000137
- Stoddart, S. (2022b). "The creation and maintenance of powerful places in Etruria" in *What if we build this here? Spatial patterns, community organization, and identity at nucleated settlements*. eds. A. Gyucha and R. B. Salisbury, IEMA Distinguished Monograph Series (Buffalo: SUNY Press), 200–211.
- Stoddart, S. (2024). "Science@Tarquinia: applying methods towards an understanding of site formation processes, mobility, diet, biology and human infrastructure in the early stages of Tarquinia" in 40 anni di scavi, ricerche e attività dell'Università degli Studi di Milano a Tarquinia, Atti del convegno in omaggio a Maria Bonghi Jovino, Tarquinia 17–18 settembre 2022. eds. G. Bagnasco Gianni and A. P. Pernigotti (Milano: Milano University Press), 33–44.
- Stoddart, S., and Malone, C. (2022). "A geoarchaeological agenda for Tyrrhenian Central Italy" in *Inspired geoarchaeology: Past landscapes and social change. Essays in honour of professor Charly French*. eds. F. Sulas, H. Lewis and M. Arroyo-Lewis (Cambridge: McDonald), 157–165.
- Stoddart, S., and Redhouse, D. (2014) The Umbrians: an archaeological perspective M. Abersson, M.C. Biella, M. Wullschleger and Fazio M. Di Entre archéologie et histoire: dialogues sur divers peuples de l'Italie préromaine (Genève Université de Genève - Faculté des Lettres - Département des Sciences de l'Antiquité) 107–124
- Stoddart, S., Woodbridge, J., Palmisano, A., Mercuri, A.-M., Mensing, S., Colombaroli, D., et al (2019). Tyrrhenian central Italy: Holocene population and landscape ecology. Holocene. Special issue. *The changing face of the Mediterranean: land cover, demography and environmental change.* 29: 761–75. doi: 10.1177/0959683619826696
- Stoddart, S. (2010). Boundaries of the State in Time and Space: Transitions and Tipping Points. *Social Evolution & History* 9, 28–52.
- Stopponi, S. (2011). Campo della fiera at Orvieto: new discoveries. *J. Roman Archaeol.* S81, 16–44.
- Styring, A. K., Charles, M., Fantone, F., Hald, M. M., McMahon, A., Meadow, R. H., et al. (2017). Isotope evidence for agricultural extensification reveals how the world's first cities were fed. *Nat. Plants* 3:17076. doi: 10.1038/nplants.2017.76
- Tagliamonte, G. (2017). "Political organization and magistrates" in *Etruscology*, ed. A. Naso (Berlin: De Gruyter), 121–142.
- Terrenato, N. (2019). *Early roman expansion into Italy. Elite negotiation and family agendas.* Cambridge: Cambridge University Press.
- Thompson, V. D. (2023). Considering urbanism at mound key (Caalus), the capital of the Calusa in the 16th century, Southwest Florida, USA. *J. Anthropol. Archaeol.* 72:101546. doi: 10.1016/j.jaa.2023.101546
- Tilley, C. Y. (1994). *A phenomenology of landscape: Places, paths and monuments.* Oxford: Berg.
- Torelli, M. (1981). *Storia degli Etruschi.* Roma-Bari: Editori Laterza.
- Trentacoste, A. (2020). Fodder for change: animals, urbanisation, and socio-economic transformation in protohistoric Italy. *Theoretical Roman Archaeol. J.* 3:1. doi: 10.16995/traj.414
- Trentacoste, A., Lightfoot, E., Le Roux, P., Buckley, M., Kansa, S. W., Esposito, C., et al. (2020). Heading for the hills? A multi-isotope study of sheep management in first-millennium BC Italy. *J. Archaeol. Sci. Rep.* 29:102036. doi: 10.1016/j.jasrep.2019.102036
- Trentacoste, A., MacKinnon, M., Day, C., le, P., Buckley, M., McCallum, M., et al. (2023). Isotopic insights into livestock production in Roman Italy: diet, seasonality, and mobility on an imperial estate. *Environ. Archaeol.*, 1–23. doi: 10.1080/14614103.2023.2282866
- Trentacoste, A., Nieto-Espinet, A., Guimarães, S., Wilkens, B., Petrucci, G., and Valenzuela-Lamas, S. (2021). New trajectories or accelerating change? Zooarchaeological evidence for Roman transformation of animal husbandry in northern Italy. *Archaeol. Anthropol. Sci.* 13:25. doi: 10.1007/s12520-020-01251-7
- Tabolli, J., and Cerasuolo, O. (2019). *Veii.* (First edition) (Austin: University of Texas Press).
- Trentacoste, A., and Lodwick, L. (2023). Towards an agroecology of the Roman expansion: Republican agriculture and animal husbandry in context. In S. Bernard, L. Mignone and D. Padilla Peralta. (eds.), *Making the Middle Republic: New Approaches to Rome and Italy, 400-200 BCE.* (Cambridge: Cambridge University Press), 164–90.
- Vanzetti, A. (2002). Some current approaches to protohistoric centralisation and urbanisation in Italy. In Attema, P., Burger, G.-J., van Joolen, E., van Leusen, M., and Mater, B. (eds.), *New developments in Italian landscape archaeology. Theory and methodology of field survey, land evaluation and landscape perception, pottery production and distribution. Proceedings of a three-day conference held at the University of Groningen, April 13–15, 2000.* Oxford: BAR, 36–51.
- Vanzetti, A. (2004). "Risultati e problemi di alcune prospettive di studio della centralizzazione e urbanizzazione di fase protostorica in Italia" in *Centralization, early urbanization and colonization in first millennium BC Italy and Greece*. ed. P. Attema (Leuven: Peeters), 1–28.
- Vernesi, C., Caramelli, D., Dupanloup, I., Bertorelle, G., Lari, M., Cappellini, E., et al. (2004). The Etruscans: a population-genetic study. *Am. J. Hum. Genet.* 74, 694–704. doi: 10.1086/383284
- von Eles, P., and Baldelli, G. (2017). "Romagna and the marches" in *Etruscology*. ed. A. Naso (Berlin: De Gruyter), 76–77.
- Ward-Perkins, J. B. (1959). The problem of Etruscan origins. *Harv. Stud. Class. Philol.* 64, 1–25. doi: 10.2307/310936
- Ward-Perkins, J. B. (1961). *Veii. The historical topography of the ancient city.* *Pap. Br. Sch. Rome* 29, 1–123. doi: 10.1017/S0068246200010916
- Wolf, D., and Faust, D. (2015). Western mediterranean environmental changes: evidences from fluvial archives. *Quat. Sci. Rev.* 122, 30–50. doi: 10.1016/j.quascirev.2015.04.016
- Wright, H. T. (2006). Early state dynamics as political experiment. *J. Anthropol. Res.* 62, 305–319. doi: 10.3998/jar.0521004.0062.301
- Wrigley, E. A. (1967). A simple model of London's importance in changing English society and economy 1650–1750. *Past Present* 37, 44–70. doi: 10.1093/past/37.1.44
- Yoffee, N. (2019). *The evolution of fragility: Setting the terms.* Cambridge: McDonald Institute.
- Zanini, A. (2012). Le origini Etrusche. Il quadro di riferimento della protostoria. In V. Beletti (ed.) *Le origini degli Etruschi. Storia antropologia e archeologia.* Roma: L'Erma di Bretschneider, 85–104.
- Zeviani, C. (2023). *Invisible etruscans. A study on rural landscape and settlement organisation during the urbanisation of Etruria (7th - 5th centuries BC).* Cambridge: Unpublished PhD dissertation.
- Zeviani, C. (2025). Urbanization halted: regional politics and demographic changes between the 7th and the 5th centuries BCE in north Etruria. *World Archaeol.* doi: 10.1080/00438243.2025.2488743
- Zeviani, C., Bilotti, G., Simmons, C., and Stoddart, S. (2025). Pointing out the pattern: modelling human-environmental dynamics in Etruria during the 1st millennium BCE. *J. Archaeol. Sci. Rep.* 62:105052. doi: 10.1016/j.jasrep.2025.105052
- Zeviani, C., and Stoddart, S. (2025). "Città aperte aggiornate (1993-2023)" in *Dal Tirreno al Mare Sardo. Studi per Marco Rendeli Firenze (Florence: Biblioteca di Studi Etruschi)*, 3–15.

Frontiers in Human Dynamics

Explores the resilience and adaptation of humans
to our changing world

An innovative journal that explores the
sociological and demographic patterns of
human adaptation to changes such as climate
emergency, modernization, population shift, and
displacement.

Discover the latest Research Topics

See more →

Frontiers

Avenue du Tribunal-Fédéral 34
1005 Lausanne, Switzerland
frontiersin.org

Contact us

+41 (0)21 510 17 00
frontiersin.org/about/contact



Frontiers in Human Dynamics

