Skeletal Remains & Human Migration & Integration

Dr Arwa KHAROBI

Defining Mobility & Migration

Challenging: due to the complex nature of classifying various mobile behaviors

This difficulty is exacerbated by the limitations and biases inherent in the **archaeological record**

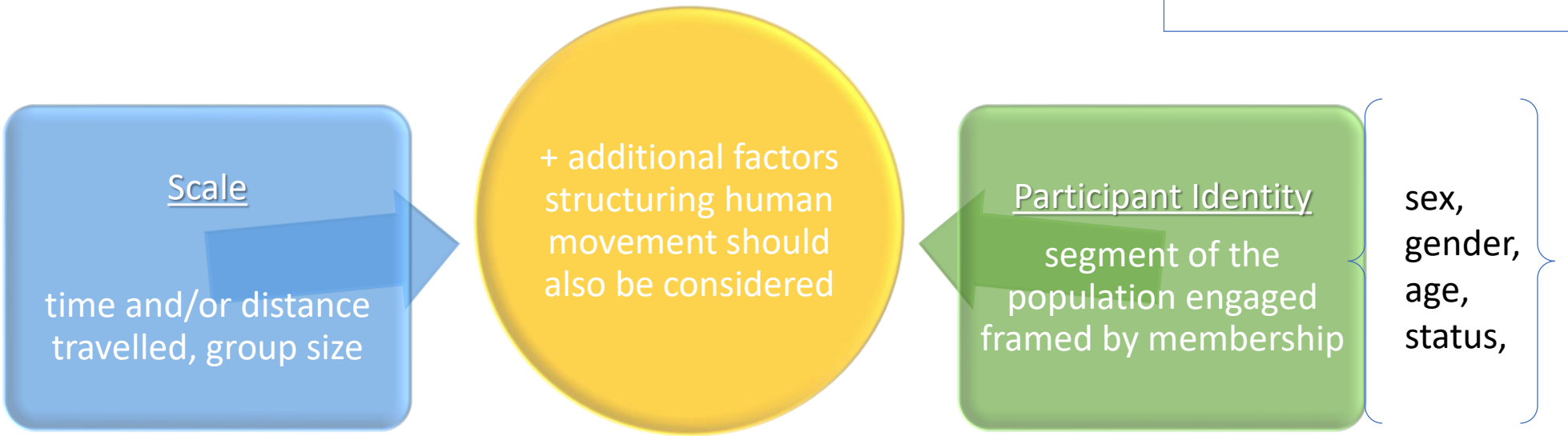
Efforts to create consistent definitions for how people move around have faced pushback & criticism

Because rigid definitions, based on fixed boundaries, often overlook the dynamic way human societies are organized and the various ways they produce things that shape a community

Using basic labels to describe movement (like mobile or sedentary, hunter-gatherer or farmer) has led to oversimplified models that focus too much on single reasons for moving (food).

This approach ignores the diverse motivations for mobility (ideological, religious, economic, climatic factors, escaping persecution, violence, or conflict).

Diversity in motivations of mobility must certainly be recognized



Challenge in Terminology: Creating terms for mobile behaviors is difficult.
Complexity Reduction: Terminology simplifies, but risks oversimplifying diverse cultures.
Moving Forward Dilemma: How do we proceed given these challenges?

Factors structuring human movement

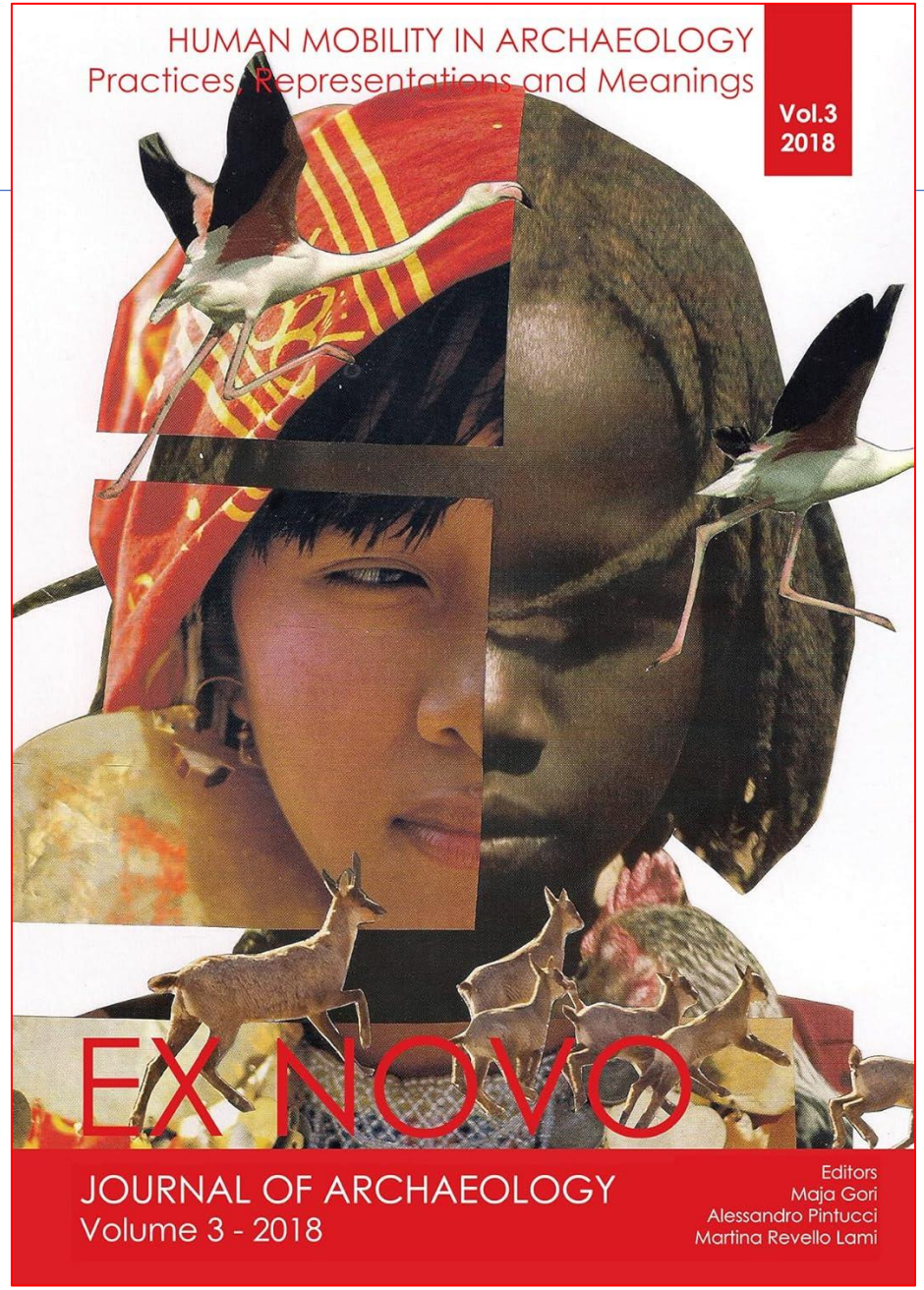
1. Scale

time & distance travelled

1.1. Mobility

individual or group movement across shorter distances that typically takes place within one's own cultural and/or political boundaries (Tsuda et al. 2015).

- ❑often seasonal, movements for resource access;
- ❑sometimes driven by:
  - deeper place understanding
  - kinship ties,
  - social support
  - economic or marital reasons



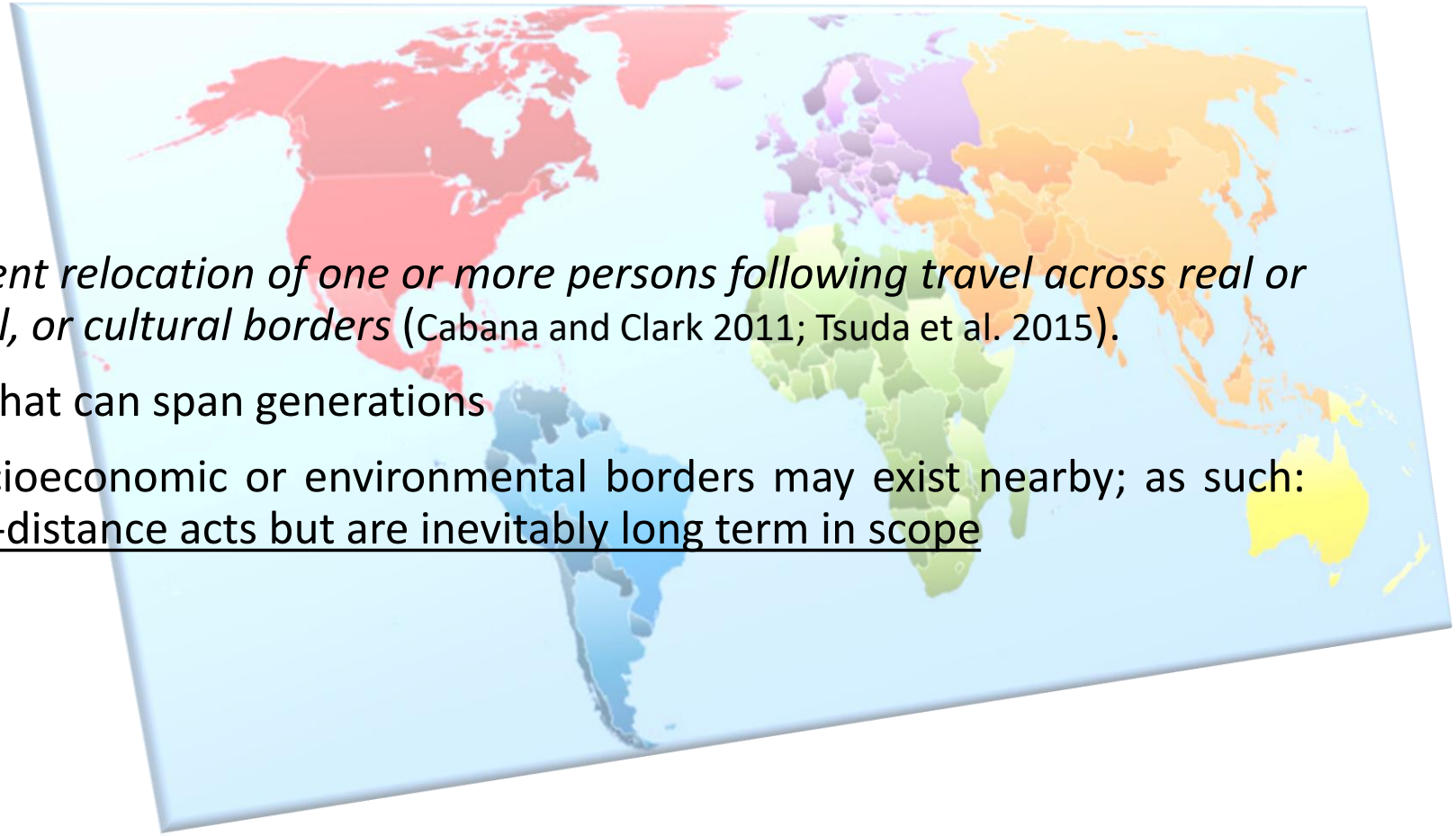
1. Scale

time & distance travelled

1.2. Migration

a one-way, long-term or permanent relocation of one or more persons following travel across real or perceived political, environmental, or cultural borders (Cabana and Clark 2011; Tsuda et al. 2015).

- ❑a dynamic, long-term process that can span generations
- ❑but not only…. substantial socioeconomic or environmental borders may exist nearby; as such: migrations are not always long-distance acts but are inevitably long term in scope



Factors structuring human movement

1. Scale

time & distance travelled

1.2. Migration

some anthropologists question whether our modern conceptions of boundaries adequately reflect those encountered in the past.

Bernardini (2011)

Prehistoric social landscapes were likely more fluid, political boundaries less defined, and ethnic identities more inclusive

Migrations can happen across connected landscapes, challenging the idea that significant boundaries must be crossed for migration

Factors structuring human movement

1. Scale

- Scale can also refer to the number of individuals engaging in mobile behaviors
- Group size represents an important consideration in examining the social structure of mobility or migration practices.
- Individuals in small mobile groups tend to operate with relative autonomy, albeit with some rudimentary structure tied to shared motivations

subgroup may travel for trade, returning to a base settlement, driven by a collective goal. Large mobile groups, needing formal organization, are less likely for short journeys, favoring long-distance or long-term migration."

Factors structuring human movement

2. Participant Identity

Identity refers to attributes (personal perceptions of such attributes) including:

- age,
- sex,
- gender,
- social standing,
- ethnicity,

"Individual identities are shaped by ingrained societal structures, unconsciously adopted and perpetuated by community members."

Factors structuring human movement

2. Participant Identity

Various factors drive movement.

Individual choices during movement shape the process.

Actions after relocation are part of the complex interplay.

Mobility is a social process influenced by individual identity within societal structures.

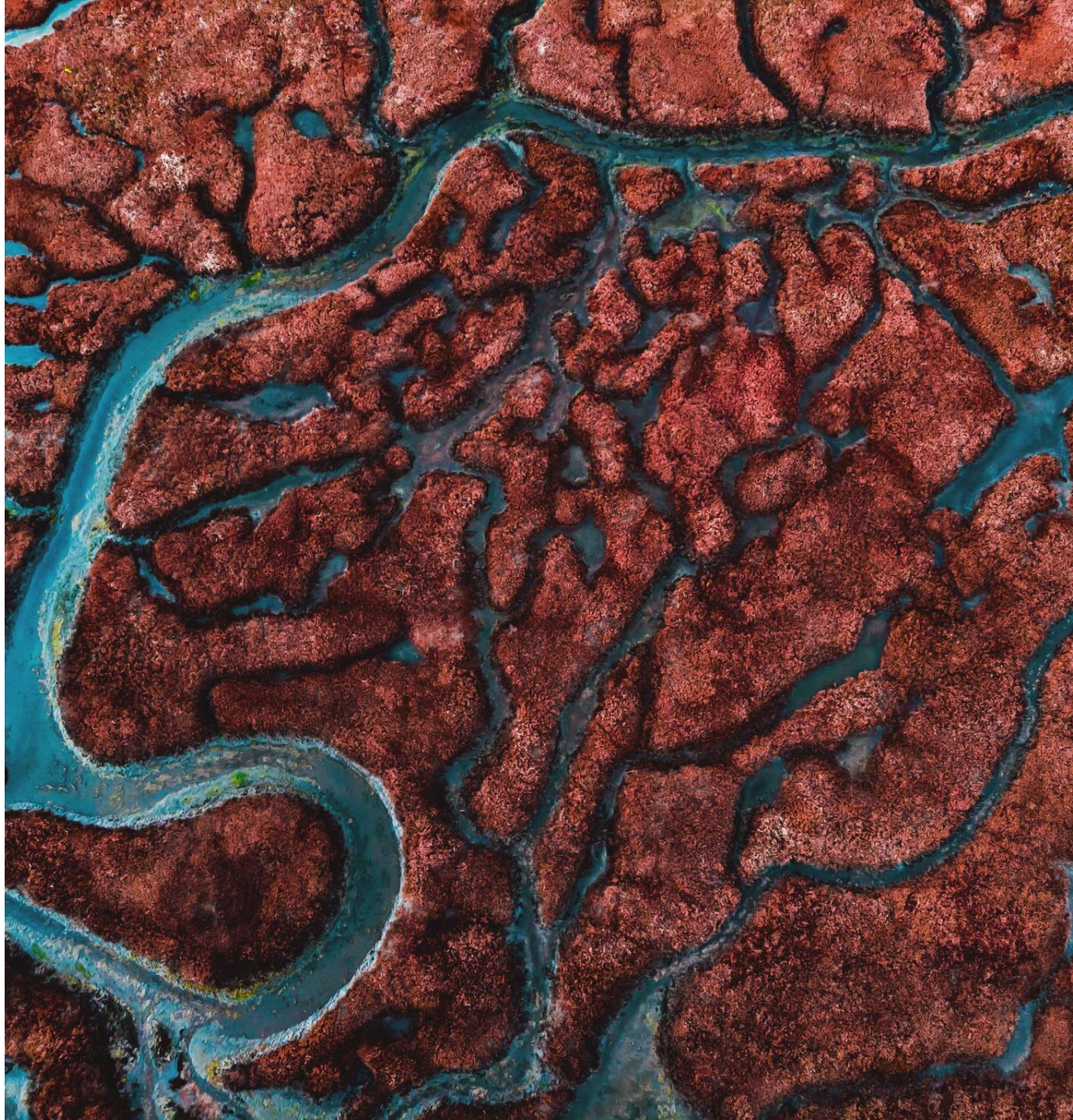
Some argue that Western or capitalist constructs influence how archaeologists perceive identity among past societies.

Emphasizes the importance of collective or relationally formed identity construction in understanding motivations and decisions of social actors.

Those studying human movement in ancient groups should acknowledge social or community identities that may override individual identities.

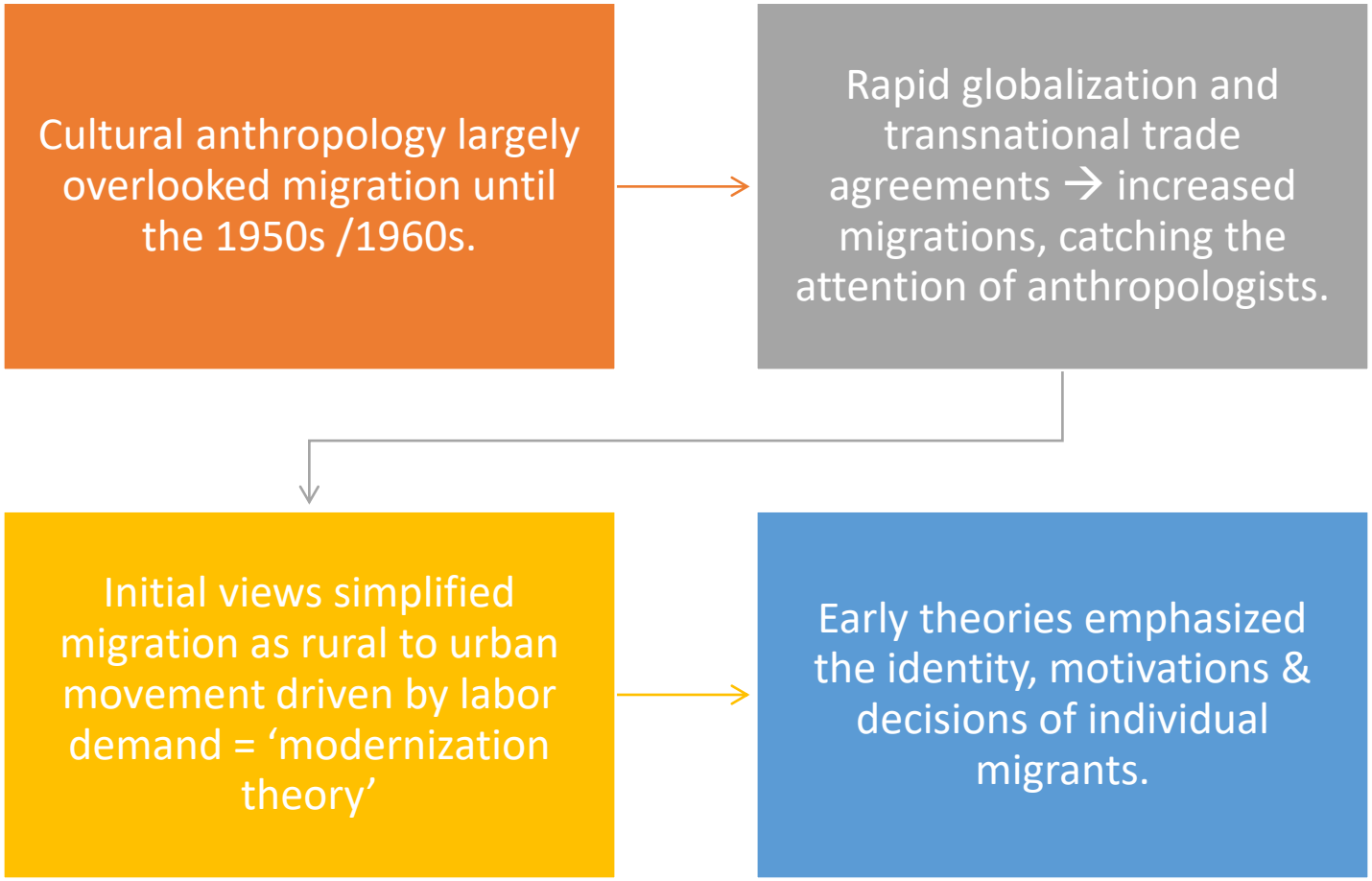
Theoretical Approaches to Migration

1. Cultural Anthropology
2. Archaeology
3. Bioarchaeology



Cultural Anthropology

1. Cultural Anthropological Approaches



Archaeology

2. Archaeological Approaches

Archaeologists, like cultural anthropologists, avoided studying migration for decades, deeming it uninteresting due to assessment challenges and difficulty in identification within the archaeological record.

Migration was often oversimplified in explanatory roles when material culture changes occurred, quickly attributed to transcultural diffusion or population replacement by incoming migratory groups.

The reluctance to study migration was rooted in a culture-historical approach, marked by racial undertones implying certain cultures or ethnic groups lacked internal innovation capabilities.

Current archaeological perspectives are changing, recognizing the need for nuanced approaches and cultural sensitivity in migration studies, challenging oversimplified explanations and racial biases.

Bioarchaeology

3. Bioarchaeological Approaches

Rare communication between past and present mobility scholars.

Assumption: Migration dynamics differ between today and prehistory.

Considerable potential for new holistic perspectives on mobile behaviors.

Migration as an inherently dynamic social process (Anthony 1997).

Anthropological & archaeological frameworks complement bioarchaeology.

Bioarchaeology relies on human behaviors "written" into bone (Agarwal & Glencross 2011).

3. Bioarchaeological Approaches

Anthony (1990)

advocates focusing on structural conditions impacting migration.

Bioarchaeology uniquely suited to assess, utilizing indicators in skeletons.

Greenblatt (2010)

emphasizes accounting for tension in mobility studies.

Bioarchaeology examines individual and social circumstances in bone changes.

3. Bioarchaeological Approaches

- Embodiment theory suggests that the body physically records environmental and social influences throughout an individual's life, allowing bioarchaeologists to directly explore lived experiences.

- The plasticity of the skeleton enables it to adapt to biosocial surroundings, providing insights into migrants' experiences influenced by movement, place, and space.

This approach is crucial for understanding the identities of socially marginalized individuals, including non-elite, female, nonadult, elderly, disabled, and queer bodies.

3. Bioarchaeological Approaches

- A person's social value may decrease after crossing borders, and this devaluation may be reflected in skeletal markers on migrant bodies, revealing structural violence
- Structural violence involves normalized harm within socioeconomic & political structures affecting vulnerable individuals or groups
- This harm can manifest as physical violence (traumatic injury), or as long-term (systemic stress across the skeleton)

This approach is valuable for assessing forced migrations, as coerced mobility may not only involve physical injury but also endemic physiological or nutritional stress.

3. Bioarchaeological Approaches

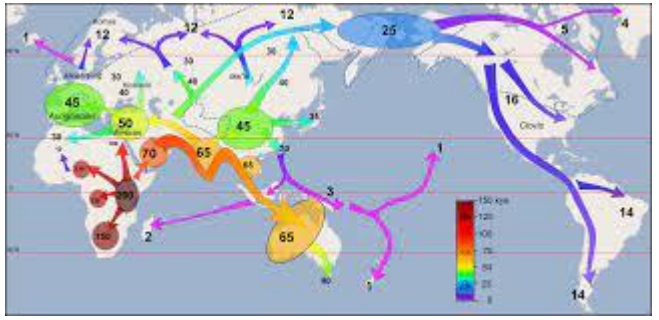
- The intersection of gender theory in cultural anthropology and archaeology with transnationalism provides a valuable avenue for bioarchaeologists to contribute to migration theory.
- Archaeologists studying gender roles use material culture to extract insights into gender dynamics among past peoples, spanning from subsistence strategies to exchange systems.
- Bioarchaeologists can bridge the gap between anthropological theory and archaeological evidence for mobility and migration.

Contributions of Bioarchaeology to Mobility & Migration Studies

- Archaeological identification of mobile and migratory behaviors remains challenging *due to the difficulty in detecting short-term or small/subgroup mobility archaeologically.*

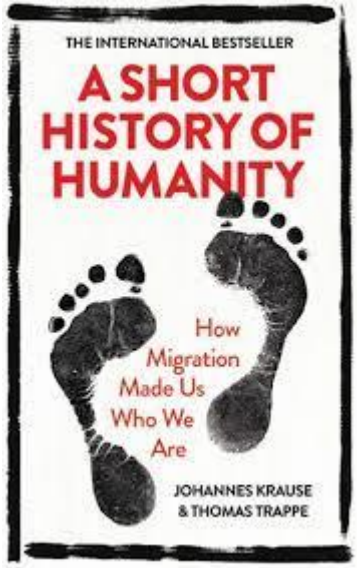
- Small/short: minimal material culture traces or significant changes to settlements
- large-scale/long-term: more noticeable changes to the archaeological record, especially when crossing significant boundaries.

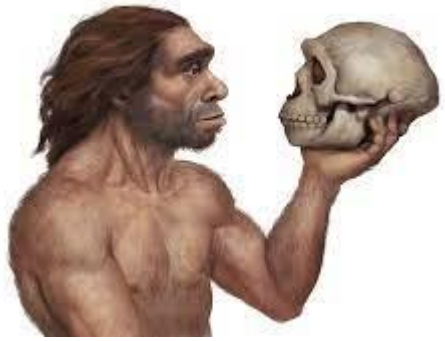
Fact: major migrations occurred infrequently compared to the more common localized mobility, making them less prevalent in the archaeological record.



Contributions of Bioarchaeology to Mobility & Migration Studies

- Much of human movement in the past remains hidden, representing an essential yet mostly invisible aspect of ancient populations
- Addressing these challenges requires innovative interdisciplinary approaches and the development of new techniques
- Bioarchaeology has shown promise in advancing research on human movement and has been a key contributor to mobility studies





Contributions of Bioarchaeology to Mobility & Migration Studies

- Bioarchaeology provides a unique perspective on past human mobility by focusing on the individual level, in contrast to broader community-level approaches in archaeology.
- Bioarchaeology collects data at the individual level, compiling detailed life histories that offer osteobiographical narratives spanning infancy to adulthood.
- Bioarchaeology allows for the examination of smaller-scale movements throughout an individual's life, uncovering variations in mobility within the same community.
- Bioarchaeology has the potential to identify previously unrecognized intrasocietal subgroup movements, such as logistical mobility and transhumance, providing valuable insights not apparent in archaeological studies.

Addressing Migration in the Bioarchaeological Record

Numerous methodological approaches are used by bioarchaeologists to better evaluate the embodiment of mobility and migration among past populations.

Addressing Migration in the Bioarchaeological Record

1. Body modification :

1.1. Cranial modification

1.2. Dental Modification

1.3. Infra-Cranial Modification

2. aDNA Analyses

3. Biodistance

3.1. Craniometrics and Dental Metrics

3.2. Cranial and Dental Nonmetric Traits

3.3. Infra-cranial Nonmetric Traits

4. Radiogenic & Stable Isotope Analyses

4.1. Radiogenic Strontium Isotopes

4.2. Stable Oxygen Isotopes

4.3. Other Isotopes

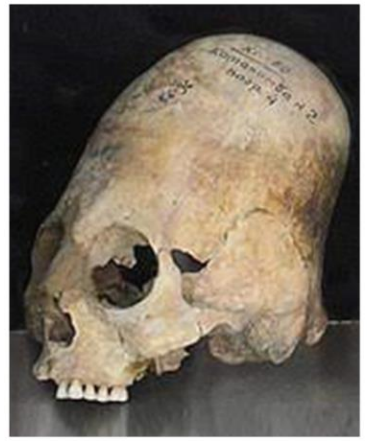
1. Body Modification

1. Body modification

- Ancient body modification was a deliberate, symbolic act with strategic intentions.
- Individuals permanently altered their bodies to convey social meanings beyond aesthetics.
- Intentional manipulation of biological forms allowed individuals to express belonging.
- Expressing belonging to ethnic, kin, or status groups through intentional body modifications.
- Group affiliation & social identity were linked to shaping body parts through embodiment.
- Individuals moving to new regions might exhibit modified skeletal features.
- We, bioarchaeologists, can identify potential migrants by examining distinct features different from the local population.

1.1. Cranial Modification

- The transformation of the head is the most studied
- Cross-Cultural & Long Historical Practice: across diverse cultures
- Extends over at least 13,000 years of human history
- The practice involves intentional application of persistent pressure to the cranial vault.
- Typically initiated during early childhood.

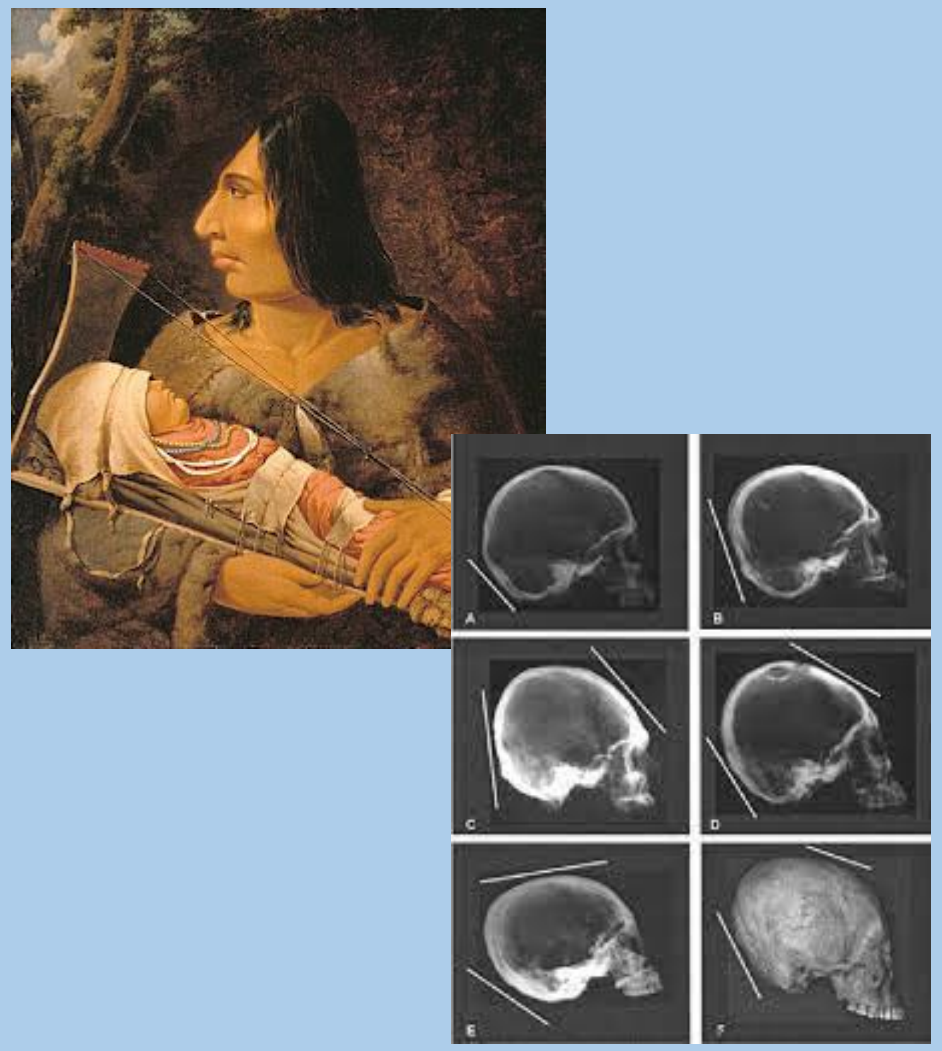


1.1. Cranial Modification

Methods of Modification:

Involves the use of straps, pads, and/or boards secured at specific angles

These tools encourage the redirection of skull development, leading to permanent modification



1.1. Cranial Modification

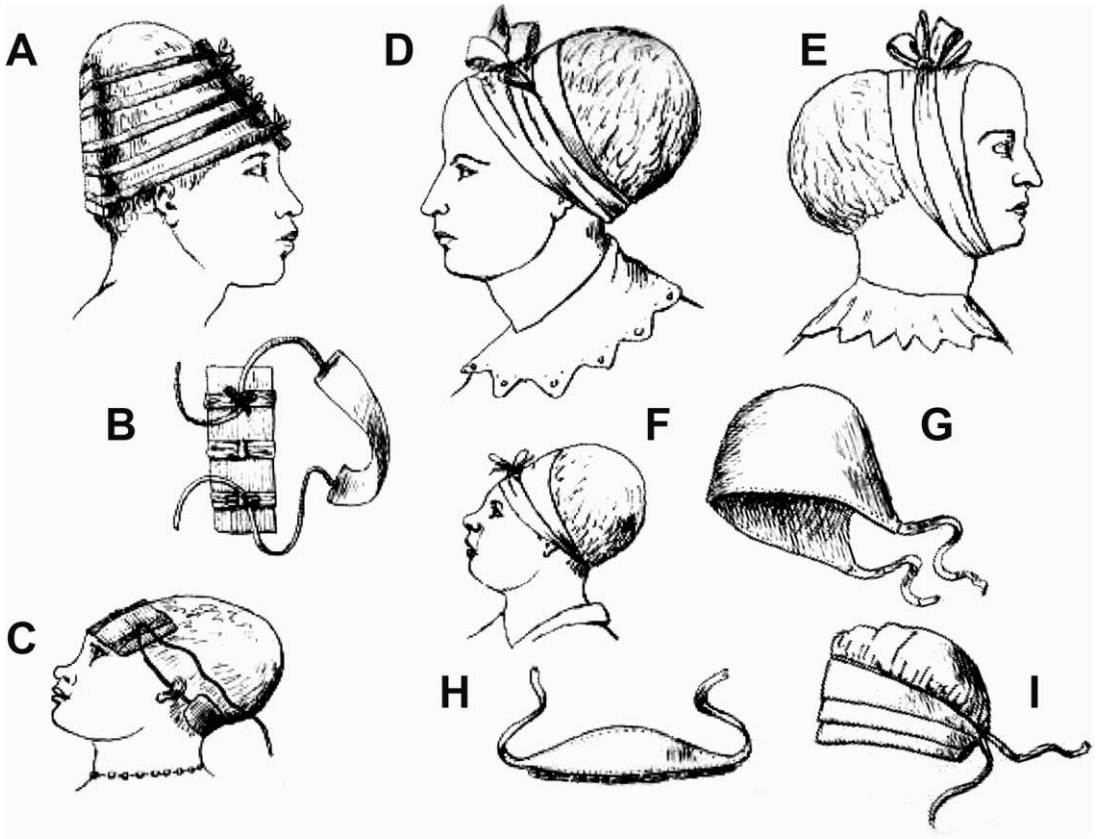
- Parents or caregivers held primary control over cranial modification decisions for young children
- Decision-making shaped by societal norms & complex power dynamics among community members
- Resulting intentionally shaped head served as a symbolic rite of passage

Cranial modification delineated complex social affiliations:

1. Kin relationships
2. Ethnicity
3. Economic status
4. Social standing

1.1. Cranial Modification

- Symbolically initiated children into full community membership or protected "ensouled" infants
- **Cranial modification stood out as migrants encountered populations with unmodified skulls or different modifications**
- **Provided a distinct marker of social identity across diverse populations**



International Journal of Paleopathology
Volume 29, June 2020, Pages 94-101

Cranial modification and the shapes of heads across the Andes

Christina Torres-Rouff [a b]

PLOS ONE

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Morphological consequences of artificial cranial deformation: Modularity and integration

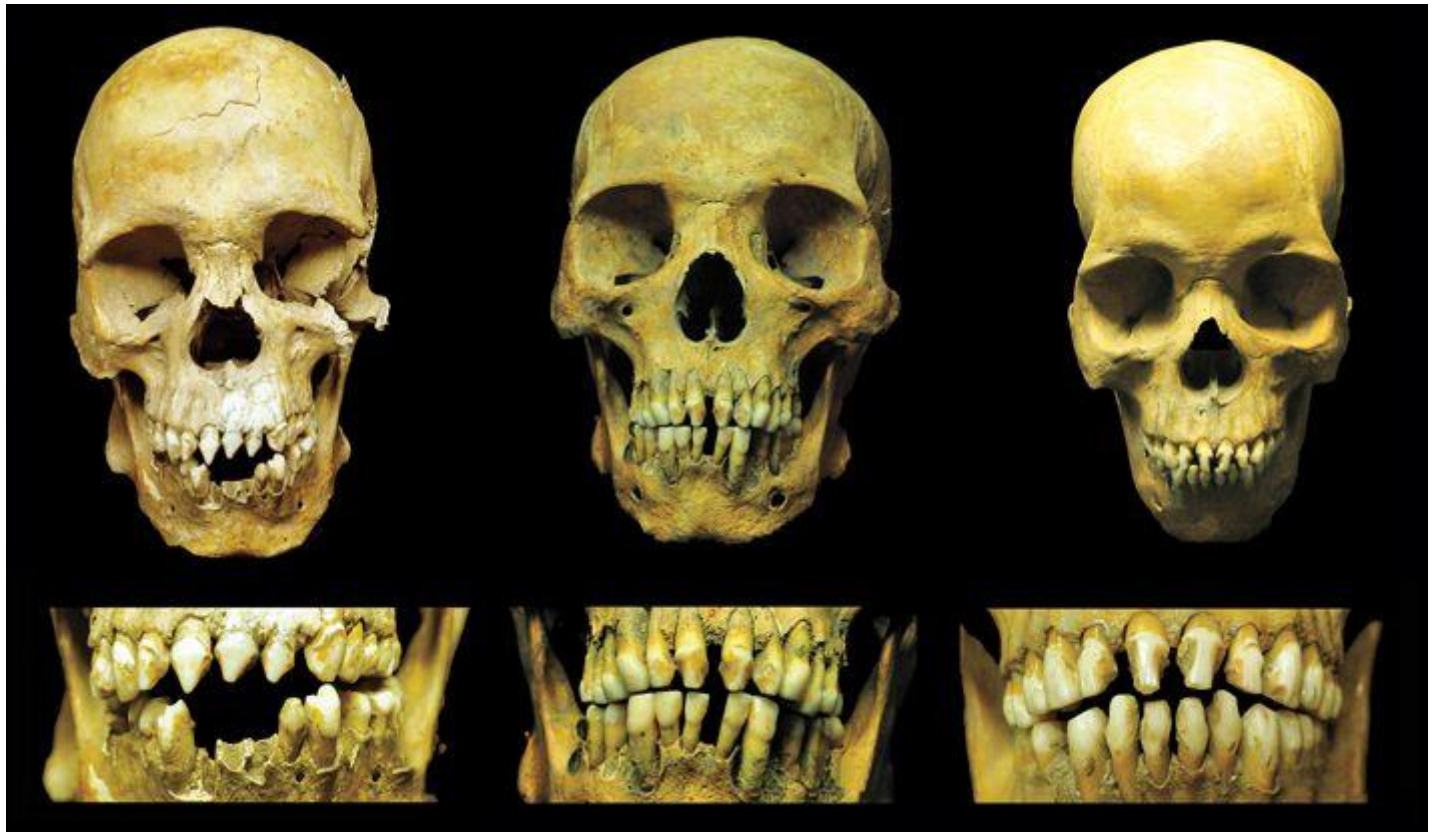
Thomas A. Püschel, Martin Friess, Germán Manríquez

Published: January 24, 2020 • https://doi.org/10.1371/journal.pone.0227362

Journal of Archaeological Science
Volume 105, May 2019, Pages 19-30

A review of the practice of intentional cranial modification in Eurasia during the Migration Period (4th – 7th c AD)

P. Mayall, V. Pilbrow



1.2. Dental Modification

A widespread practice spanning various cultural groups over thousands of years

Involved deliberate, non-therapeutic changes to teeth:

1. crown morphology
2. enamel color
3. tooth number
4. embedding decorative elements

1.2. Dental Modification

typically targeted permanent anterior teeth, especially the more conspicuous maxillary dentition

1.2. Dental Modification

Significance of Dental Modification:

- Signified aesthetic modification linked to culturally specific beauty standards.
- Used as a means of preventing harm or illness.
- Symbolic and ideological marker of maturation, occupation, social status, gender identity, or group/ethnic/kin affiliation.

1.2. Dental Modification

Relation to Mobility or Migration:

- ❑Dental modification played a role in distinguishing locals from nonlocals
- ❑Part of processes tied to mobility or migration

J Dent Res. 2008 Jan;87(1):60-4. doi: 10.1177/154405910808700110.

The effects of social class and dental attendance on oral health

A N Donaldson [1], B Everitt, T Newton, J Steele, M Sherriff, E Bower

Affiliations + expand

PMID: 18096895 DOI: 10.1177/154405910808700110

SADJ. 2007 Apr;62(3):106, 108-13.

Pulling teeth for fashion: dental modification in modern day Cape Town, South Africa

L J Friedling [1], A G Morris

Affiliations + expand

PMID: 17612385

Social Identity and Dental Modification at the Postclassic Maya Urban Centre of Mayapan

Published online by Cambridge University Press: **29 June 2021**

Stanley Serafin, Marilyn A. Masson, Carlos Peraza Lope, Douglas J. Kennett and Richard J. George

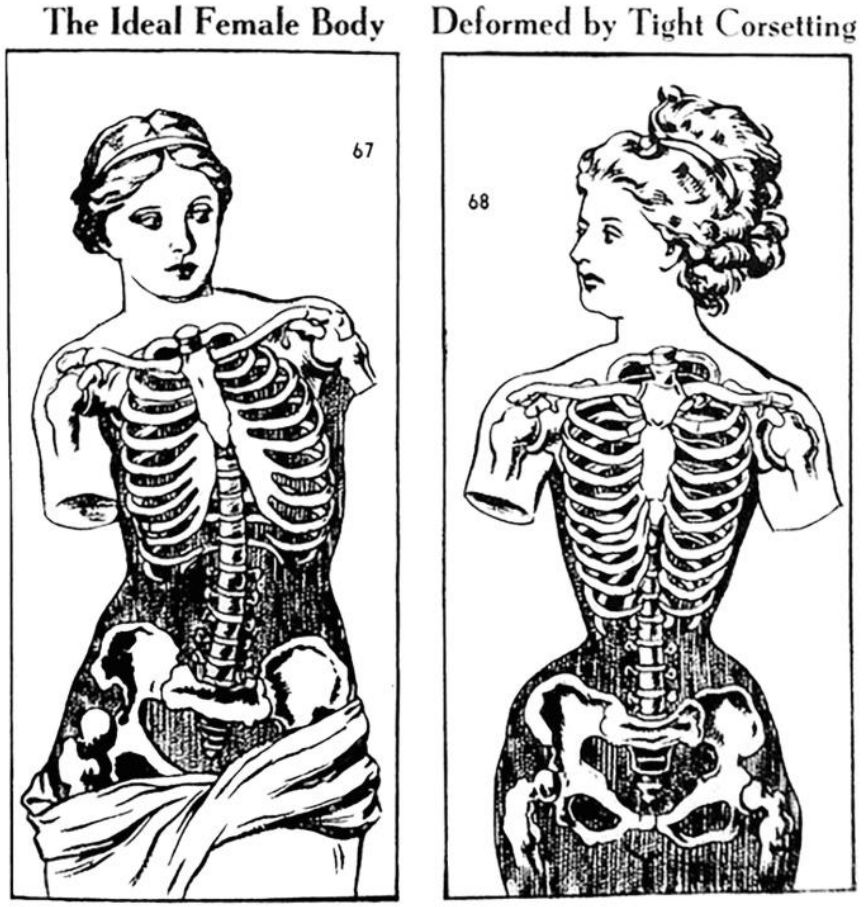
Show author details

1.3. Infra-Cranial Modification

- Infra-cranial aspects of the skeleton could undergo alterations due to culturally induced reshaping
- This reshaping often initiated in early childhood
- While culturally significant, had consequences (chronic pain & complications)
- The reshaping served to reduce mobility in individuals who underwent these practices
- Not serve as reliable indicators of movement among past individuals
- Exceptional circumstances may be required for such modifications to indicate mobility

1.3. Infra-Cranial Modification

1. neck (Chawanaputorn et al. 2007; Keshishian 1979)
2. torso (Gibson 2015, 2017; Groves et al. 2003; Stone 2012)
3. feet (Berger et al. 2019; Cummings et al. 1997; Lee 2019)



2. aDNA Analyses

- Crucial in studying migration among past populations
- Helps in identifying individual migrants within archaeological samples
- Also reveals broader patterns of interaction & movement between populations over extensive geographic areas
- Extremely degraded, fragile, & scarce due to various postmortem environmental conditions affecting biomolecules

Degradation Factors:

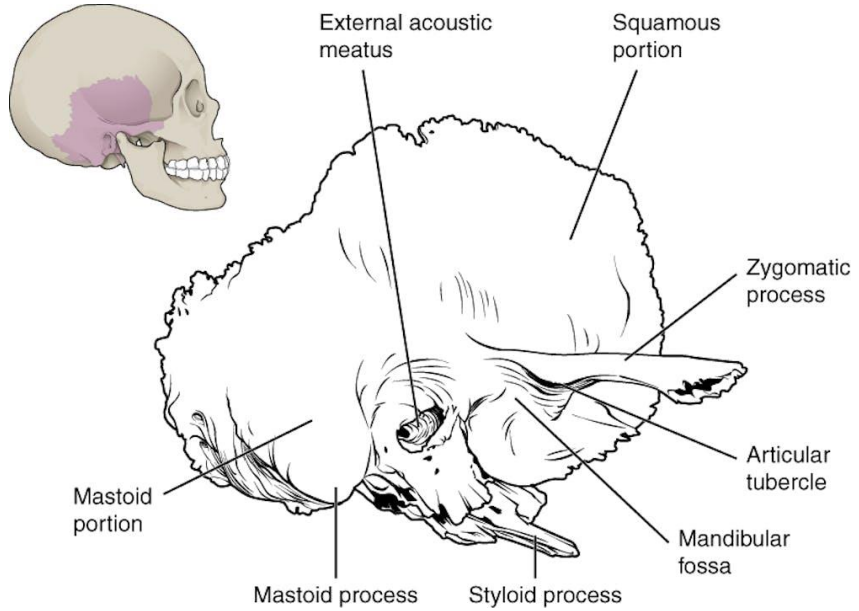
- temperature,
- humidity,
- soil
- groundwater pH,
- exposure to oxygen or water,
- microbial activity

2. aDNA Analyses

The extraction of aDNA fragments is more likely to be successful from dense cortical bone, with the petrous portion of the temporal bone being a particularly favorable source.

The petrous portion of the temporal bone can produce high yields of ancient DNA, even in tropical environments.

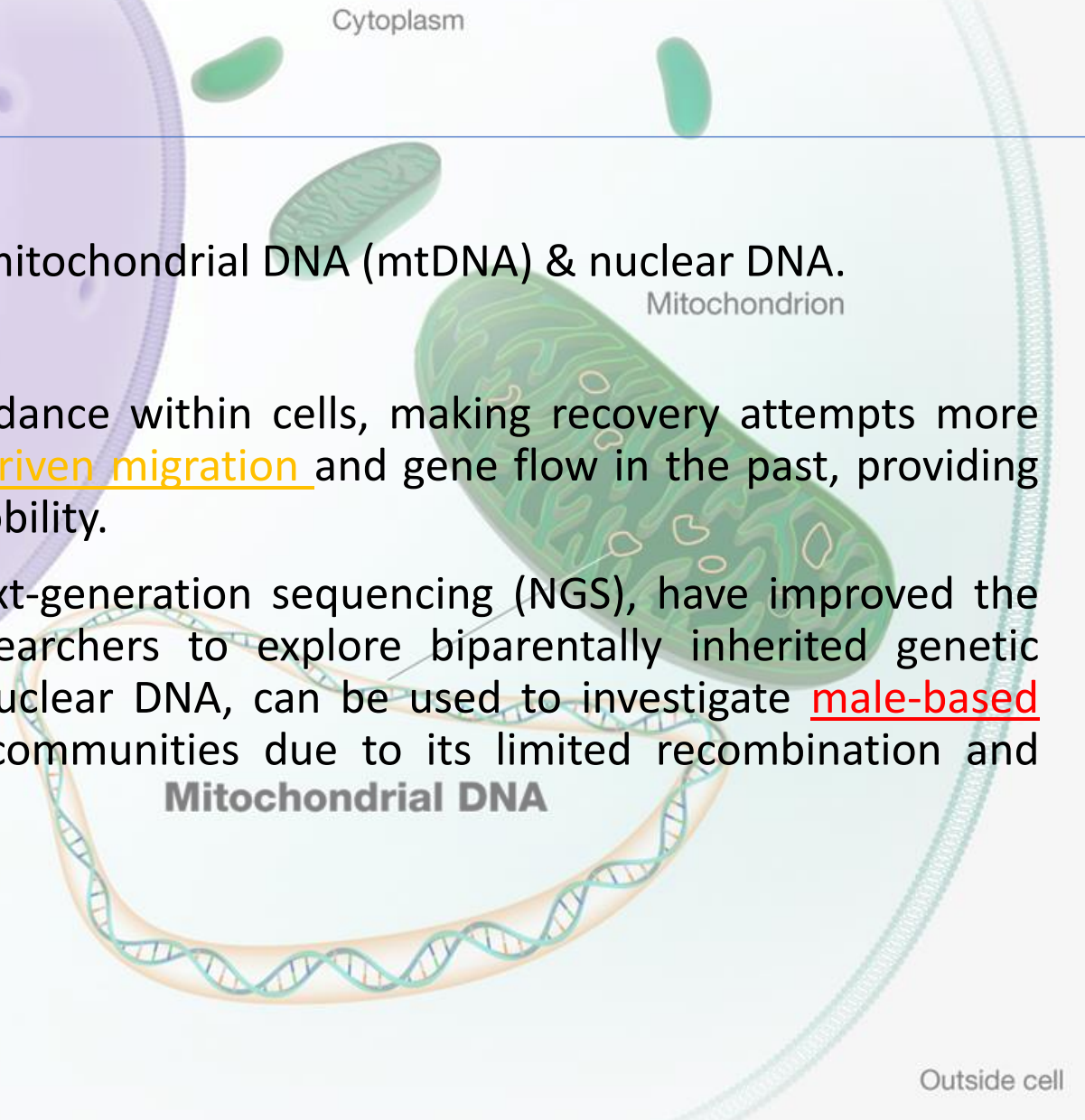
Preservation conditions play a crucial role in determining the success of aDNA extraction



2. aDNA Analyses

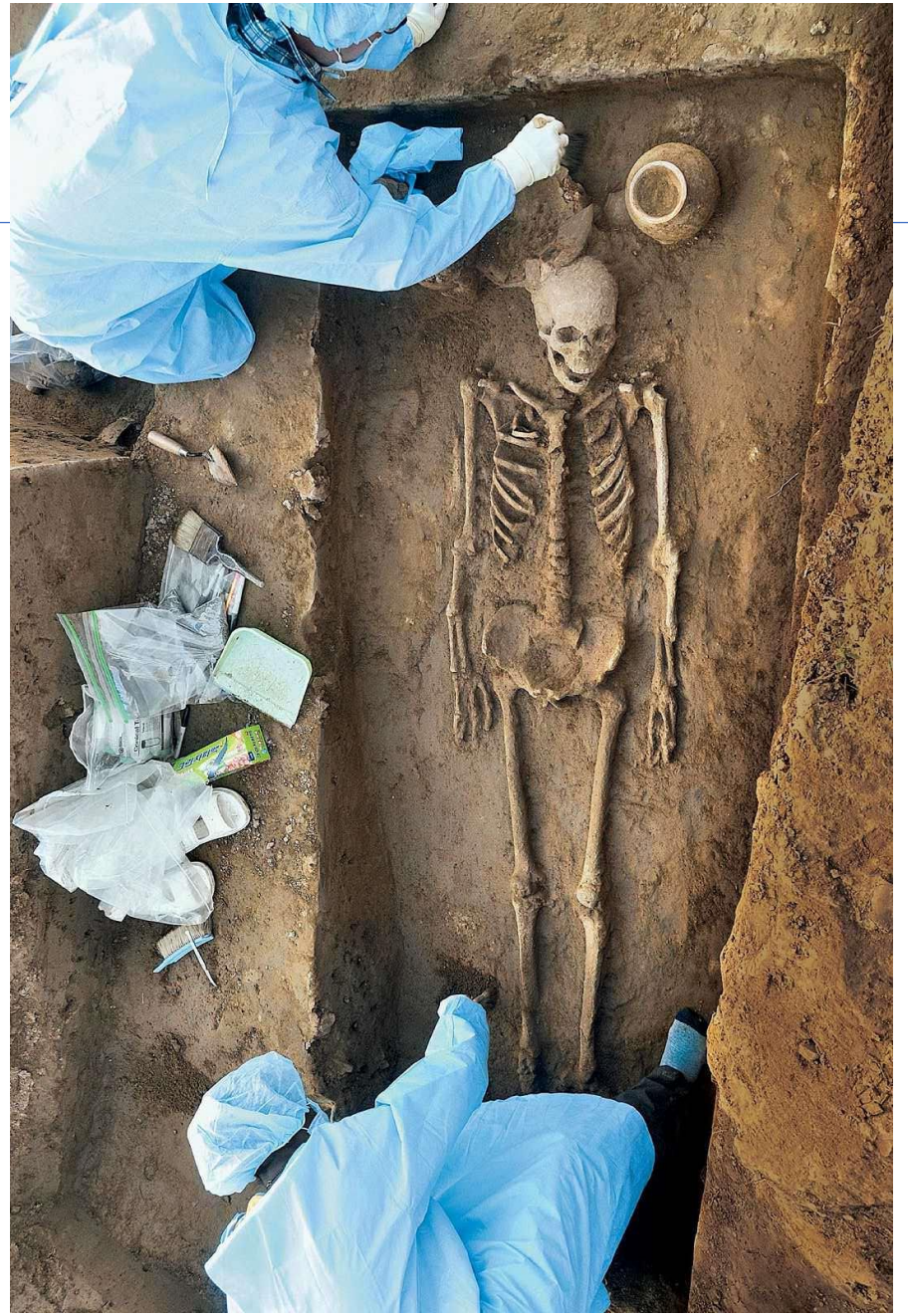
2 types of genetic material: maternally inherited mitochondrial DNA (mtDNA) & nuclear DNA.

1. **MtDNA** is preferred due to its higher abundance within cells, making recovery attempts more productive. It can reveal aspects of female-driven migration and gene flow in the past, providing insights into social organization shaped by mobility.
2. Recent advances in protocols, especially next-generation sequencing (NGS), have improved the accessibility of **nuclear DNA**, allowing researchers to explore biparentally inherited genetic material. The Y chromosome, part of the nuclear DNA, can be used to investigate male-based migrations and admixture among ancient communities due to its limited recombination and polymorphisms.



2. aDNA Analyses

- Pre-NGS aDNA analyses focused on single loci, emphasizing SNPs & STRs.
- SNPs: common genetic variations/STRs: consist of repeated short allele sequences.
- NGS advancements enable genome-wide analyses, allowing exploration of complex questions.
- We can study kinship, admixture & migration across numerous loci.
- aDNA analyses have transformed ancestry & human movement studies.
- Caution is advised in interpretations, considering associated archaeological evidence and applying anthropological perspectives.



Animal DNA

Studying the presence & origins of **domestic animals in the Neolithic** provides valuable insights into their domestication & movement patterns with early farmers

Sheep & goats were likely imported from the Near East, their center of domestication, as there were no related wild species in Southern Europe during the Neolithic

The origin of South European cattle is debated: were they separately domesticated from European wild cattle or derived from Middle Eastern stock.

Some studies suggest **a clear genetic distinction between mtDNA sequences** of Neolithic domestic & wild cattle in Central Europe, a pattern also observed in British samples.

Animal DNA

However, aDNA analysis in Southern Europe found domestic taurine haplotypes in wild auroch samples, challenging the idea of total reliance on imported domestic species and suggesting possible independent domestication.

The possibility of independent domestication in Southern Europe implies continuous exploitation of wild cattle in the early Neolithic rather than a complete dependence on imported domestic species.

The likelihood of independent domestication is seen as more plausible if there was a gradual process rather than a rapid colonization event.

Analyzing a-mtDNA from wild aurochs and domestic taurine cattle in Southern Europe and comparing it with existing sequences may provide clarity on the controversial issue of cattle domestication.

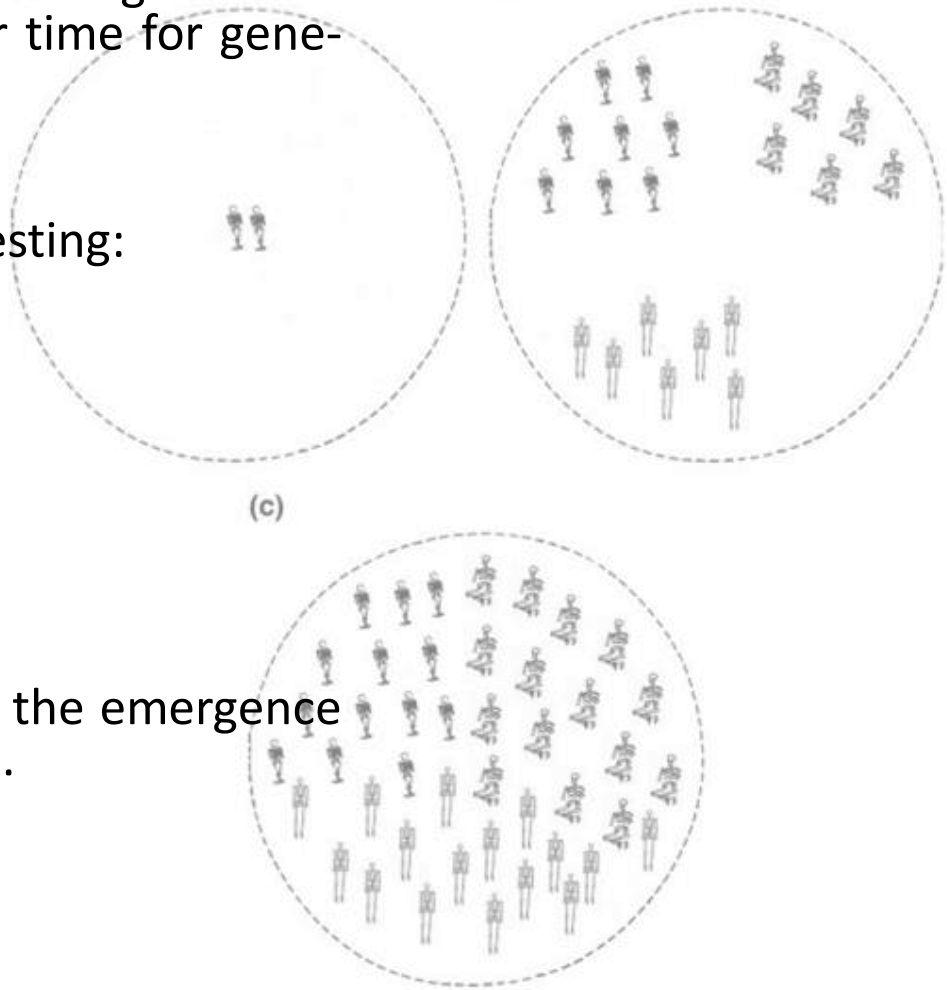
3. Biodistance

Biodistance analyses assess observable skeletal features, focusing on the cranium & dentition, assuming increased genetic similarity over time for gene-exchanging populations.

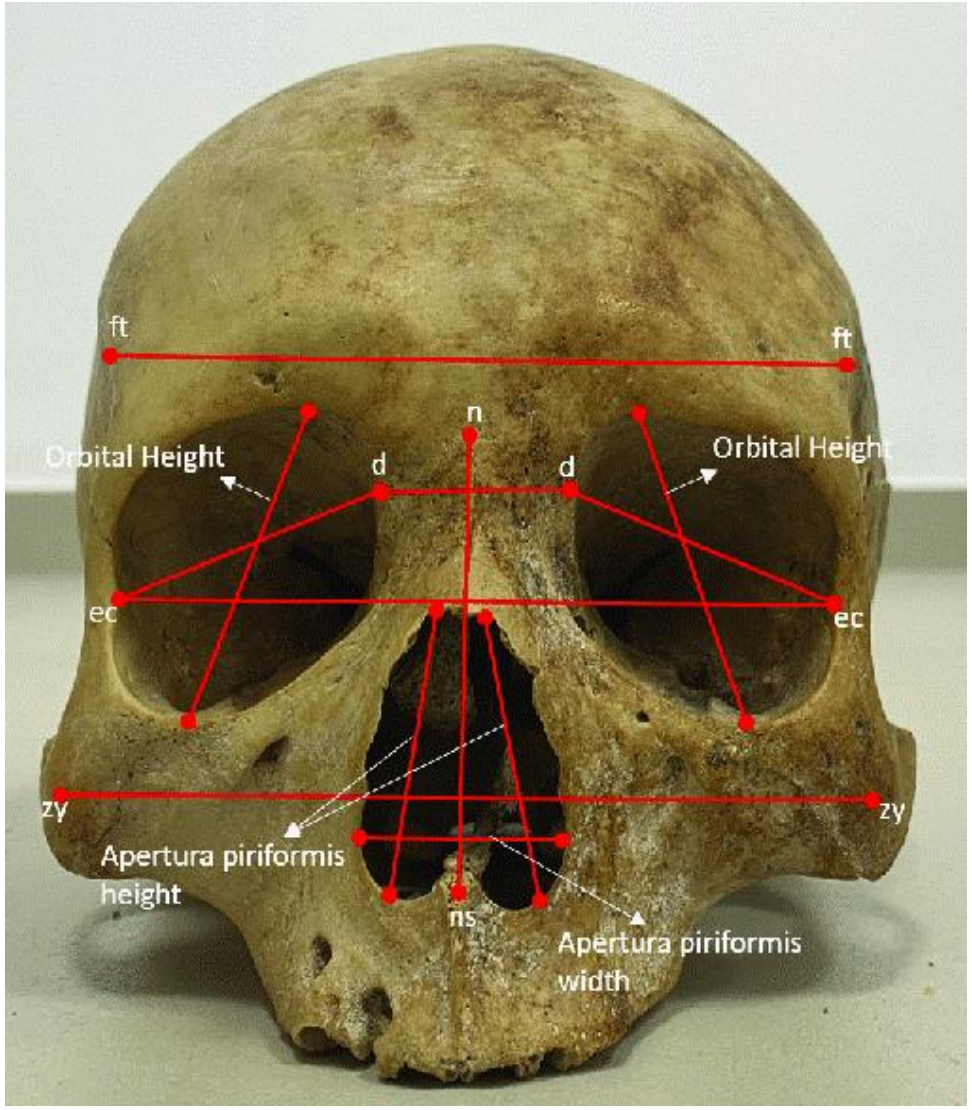
Observable traits reflect heritability & genetic information, suggesting:

1. gene flow,
2. shared common ancestors,
3. potential migration.

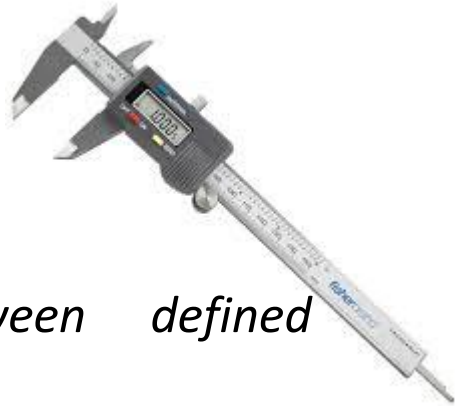
Biodistance analyses help evaluate past mobility, migration, and the emergence of ethnic or community identities through population interaction.



3.1. Craniometrics & Dental Metrics



- Utilize multivariate statistics to assess measurements on skull and teeth.
- Represent continuous variables → offer objective approach to evaluating **biological affinity** among populations.
- We focus on documented differences in facial and vault shape for skull analysis, assuming closer relatedness for populations with similar craniofacial morphology.



Measurements with calipers between defined landmarks, guide this assessment.

Article | Open access | Published: 05 February 2019

Craniometrics Reveal "Two Layers" of Prehistoric Human Dispersal in Eastern Eurasia

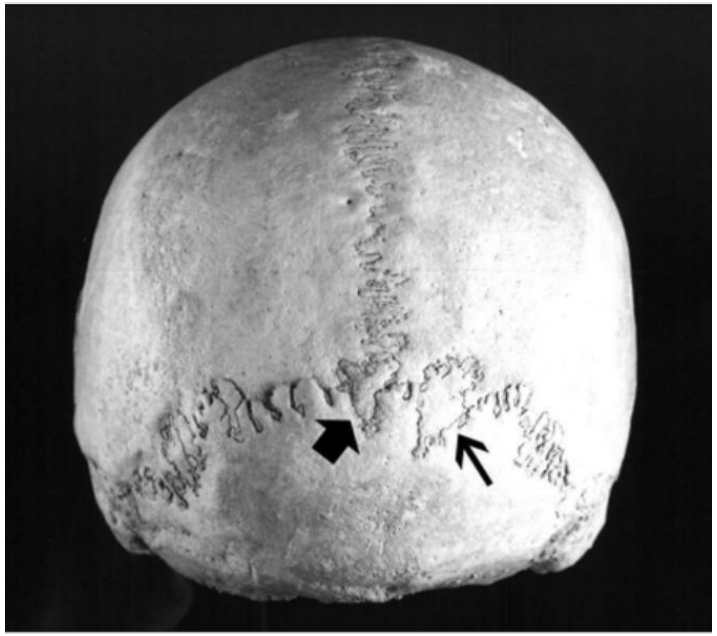
Hirofumi Matsumura, Hsiao-chun Hung, Charles Higham, Chi Zhang, Mariko Yamagata, Lan Cuong Nguyen, Zhen Li, Xue-chun Fan, Truman Simanjuntak, Adhi Agus Oktaviana, Jia-ning He, Chung-yu Chen, Chien-kuo Pan, Gang He, Guo-ping Sun, Wei-jin Huang, Xin-wei Li, Xing-tao Wei, Kate Domett, Siân Halcrow, Kim Dung Nguyen, Hoang Hiep Trinh, Chi Hoang Bui, Khanh Trung Kien Nguyen & Andreas Reinecke

Scientific Reports **9**, Article number: 1451 (2019) | Cite this article

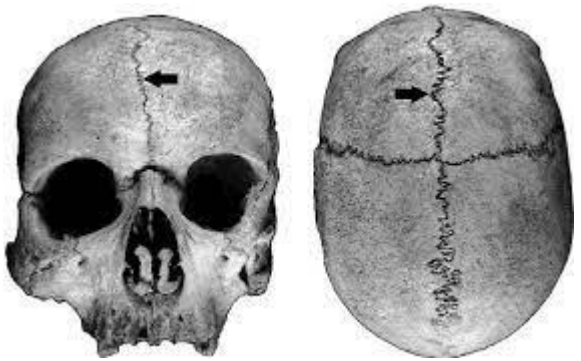
3.2. Cranial & Dental Nonmetric Traits

Nonmetric traits involve qualitatively assessing nonpathological skeletal features through morphological observation

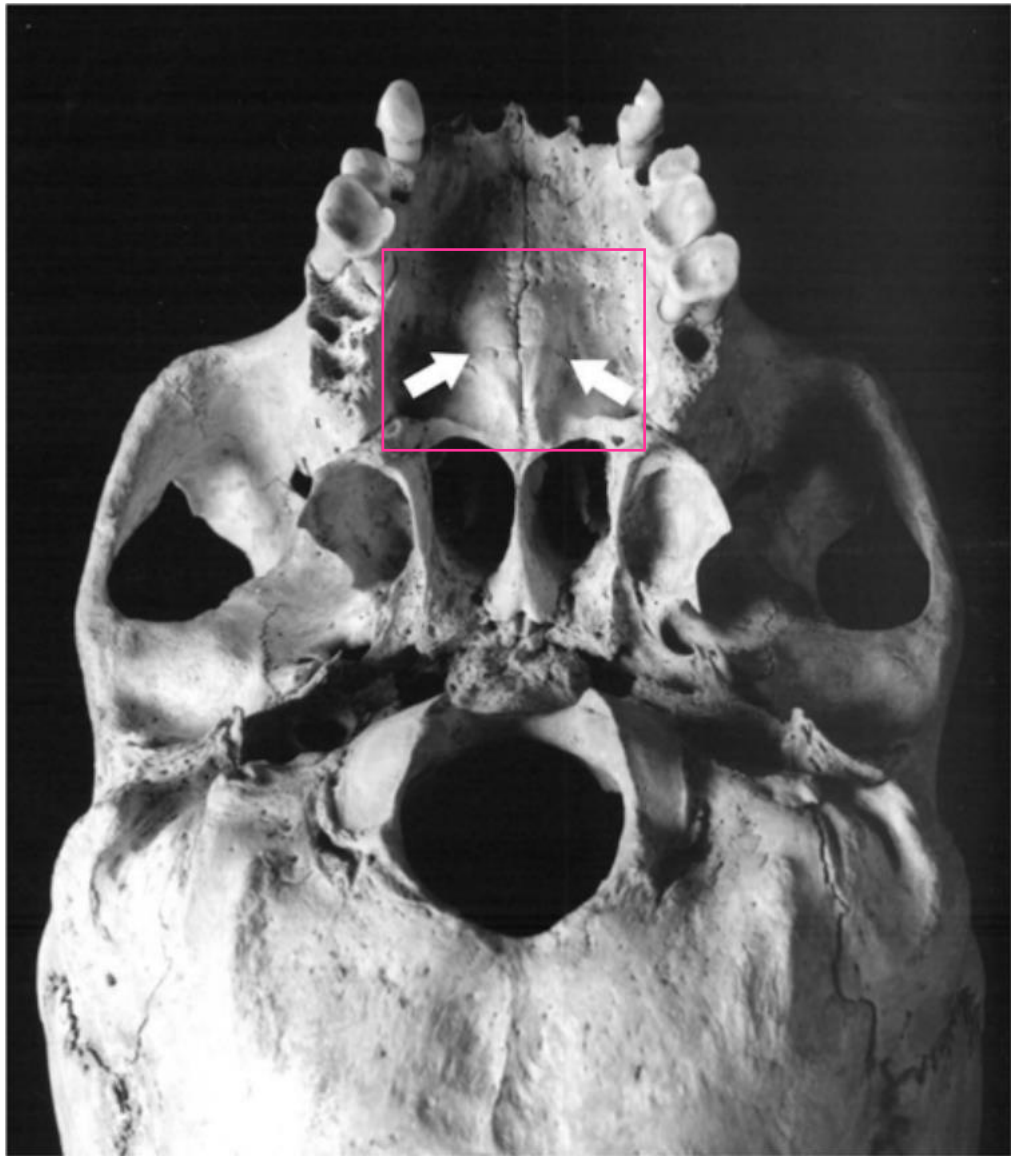
foramina numbers,
accessory ossicles,
persistent sutures,
ossification anomalies.



- Traits are scored based on presence or absence along a quasi-continuous or discrete scale.
- Indicate population affinity, with higher frequencies suggesting sustained gene flow due to mobility or migration.



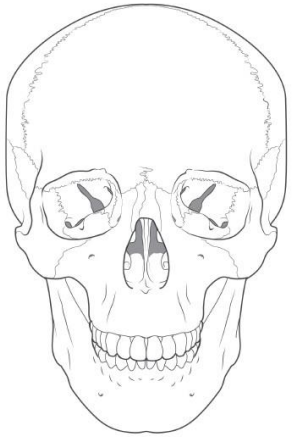
The bones forming the hard palate show development of a **bony torus along the midline** (arrows)

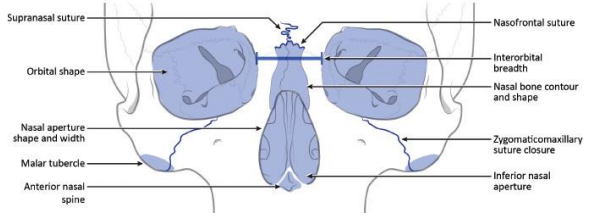


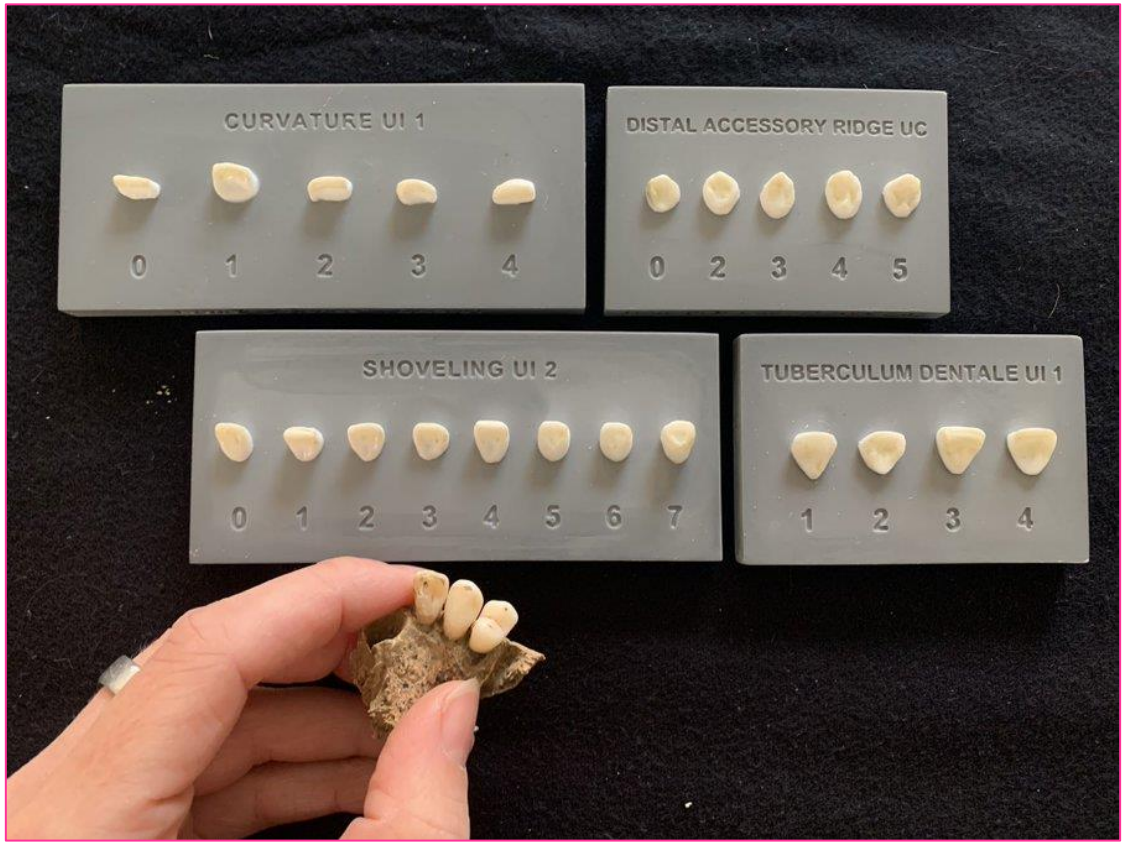
3.2. Cranial & Dental Nonmetric Traits

Nonmetric dental features considered more under genetic control, particularly in deciduous teeth (less influenced by sex or age) = valuable for assessing affinity in commingled assemblages.

Phenotypic expression of polygenic cranial nonmetric traits is more complex, with variable heritability reported.



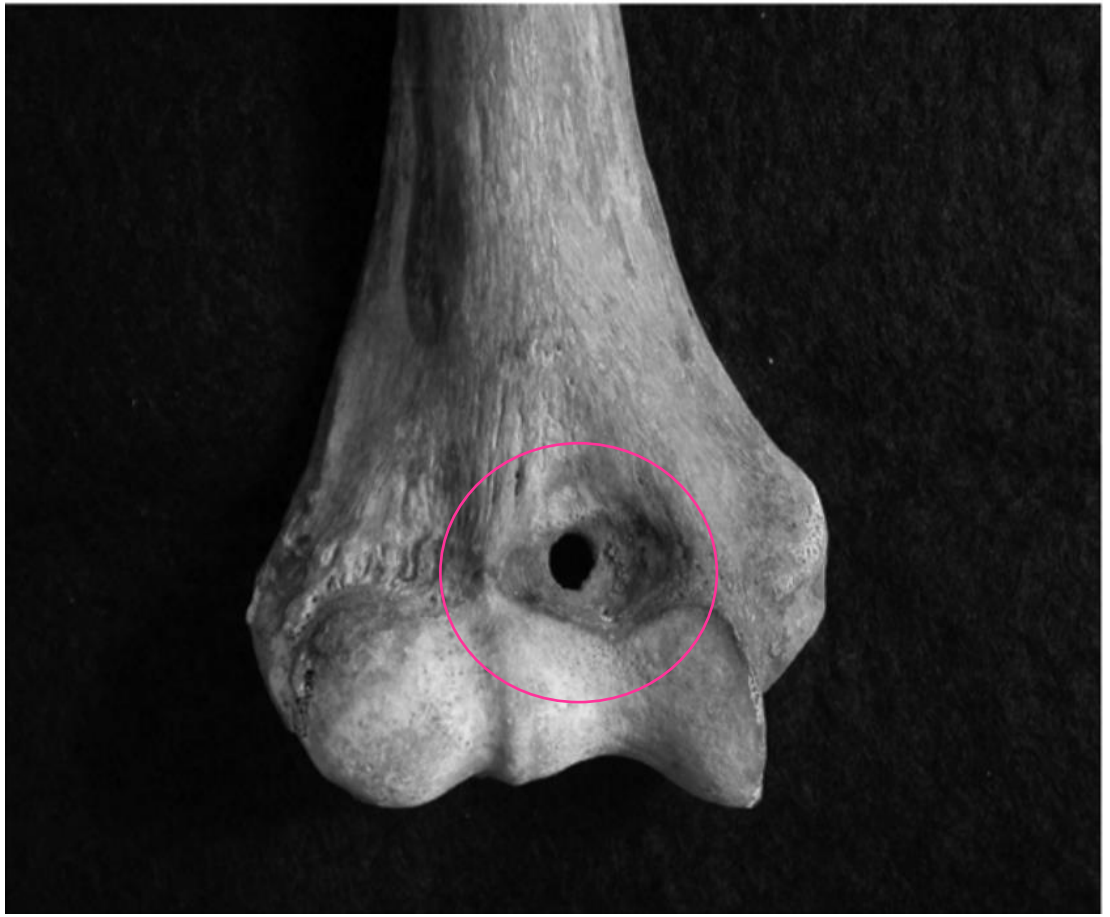




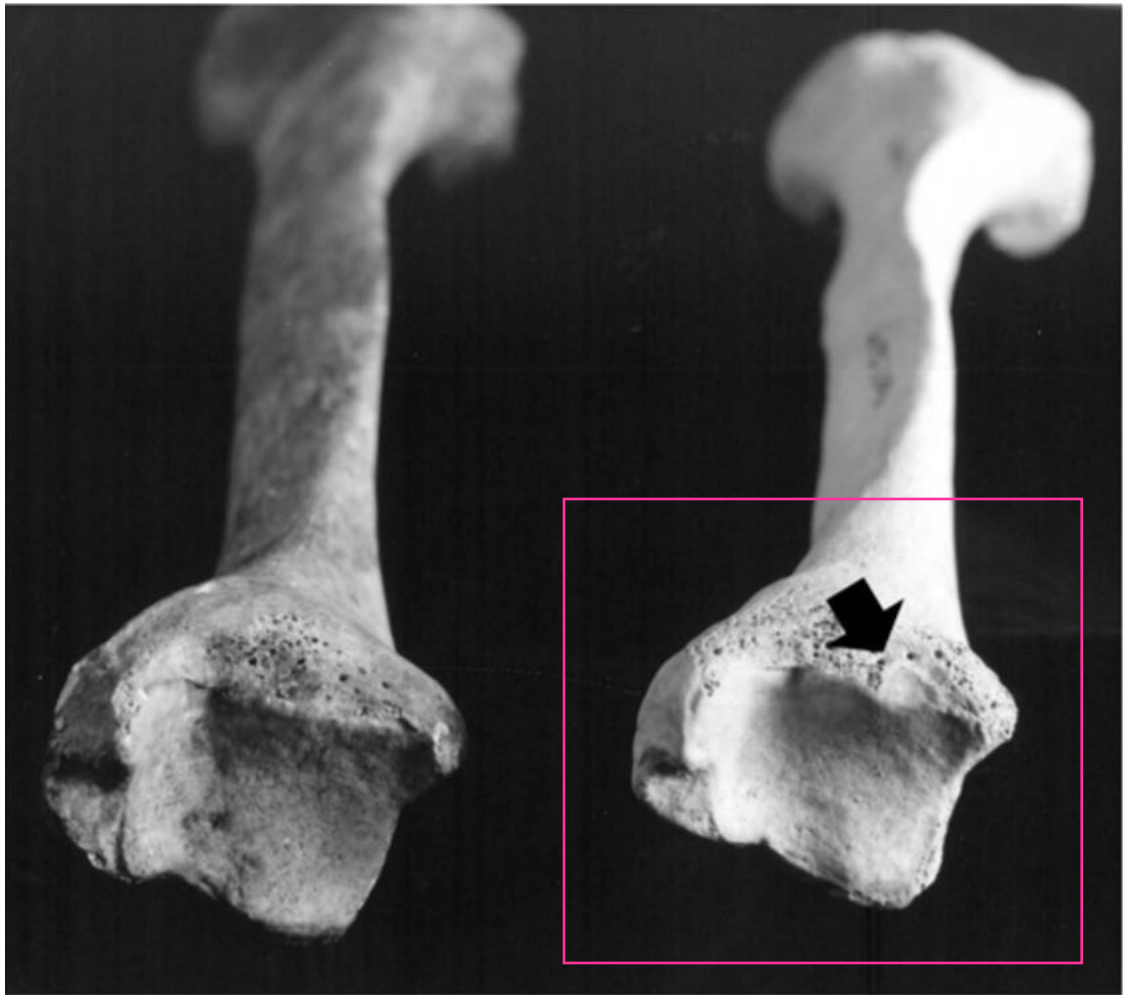
3.3. Infra-cranial Nonmetric Traits

- Received less attention due to their likely influence by factors (heritability, sex, age, diet, and function).
- The weight-bearing nature of many post-cranial bones makes them more susceptible to biomechanical forces.
- Potential utility in infra-cranial features may be explored through intra-cemetery biodistance analyses focusing on anomalous congenital conditions or uncommon traits.
- However, as these traits are infrequent in the population (less than 2%) & often present in less-studied skeletal elements (e.g., hands, feet) = fewer studies.

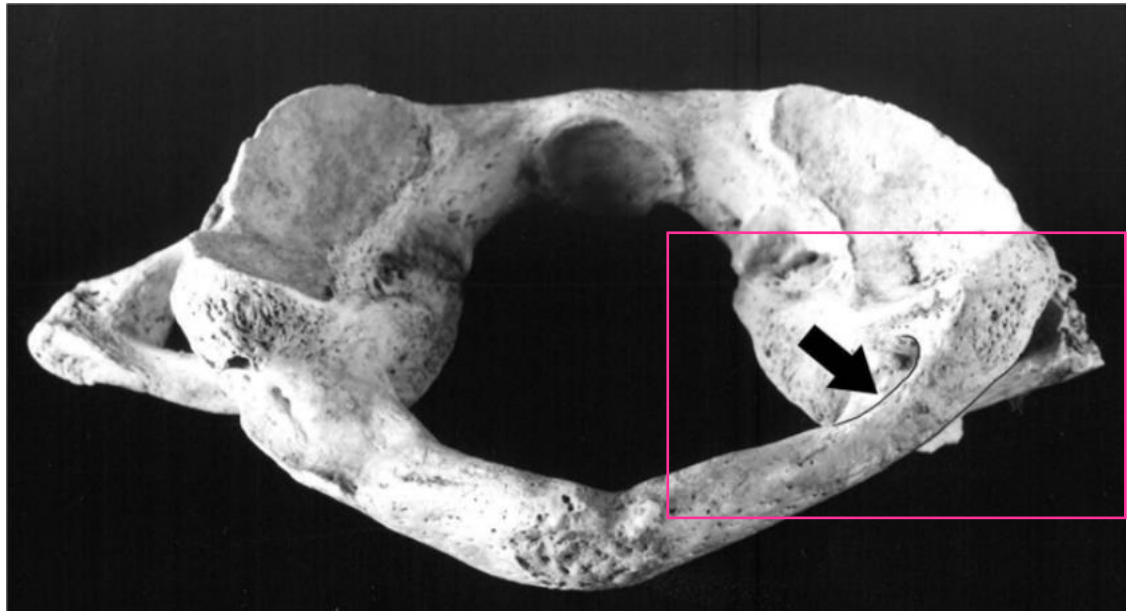
septal aperture on the humerus



Squatting facet (arrow) on the tibia



Posterior atlas bridging trait on the right side (arrowed);



4. Radiogenic & Stable Isotope Analyses

- Isotope ratios in human tissues reflect geographic provenance due to natural variations in local geology or hydrological systems.
- Skeletal tissues, forming and remodeling at different ages, allow us to trace movement patterns across an individual's life.
- Isotopic analysis of multiple individuals enables the recognition of broader trends in mobility and migration across various societal segments.
- Mobility patterns can be identified in relation to sex, gender, age, status, occupation-based groups, or entire communities.

Methodological Challenges in Biogeochemical Sampling

Bulk Samples vs. Microsampling:

Bulk samples from enamel & bone provide long-term averages, while microsampling offers a potential for more acute assessments of human movement.

Intra-Tooth Sequential Sampling:

Limited applications due to complexities in amelogenesis, enamel maturation, and fluctuating mineralization rates, producing values reflective of longer-term averages.

Bulk Sampling for Diachronic Change:

Discerning intra-individual diachronic change in movement may be better achieved through bulk sampling of multiple tissues with established formation and remodeling rates for a single individual.

Tying into Developmental Frameworks:

This approach aligns with developmental frameworks associated with life course theory

Microsampling Potential in Bone Hydroxyapatite:

Despite diagenesis challenges, **well-preserved bone hydroxyapatite** may offer a more successful microsampling alternative compared to enamel.

Bone forms incrementally, and recent research suggests that **unremodeled "pockets" of incremental layers persist**, holding potential for revealing short-term patterns of mobility.

Serial isotopic sampling of bone, especially in these unremodeled pockets, could provide discrete, chronological data points for developing individual life courses.

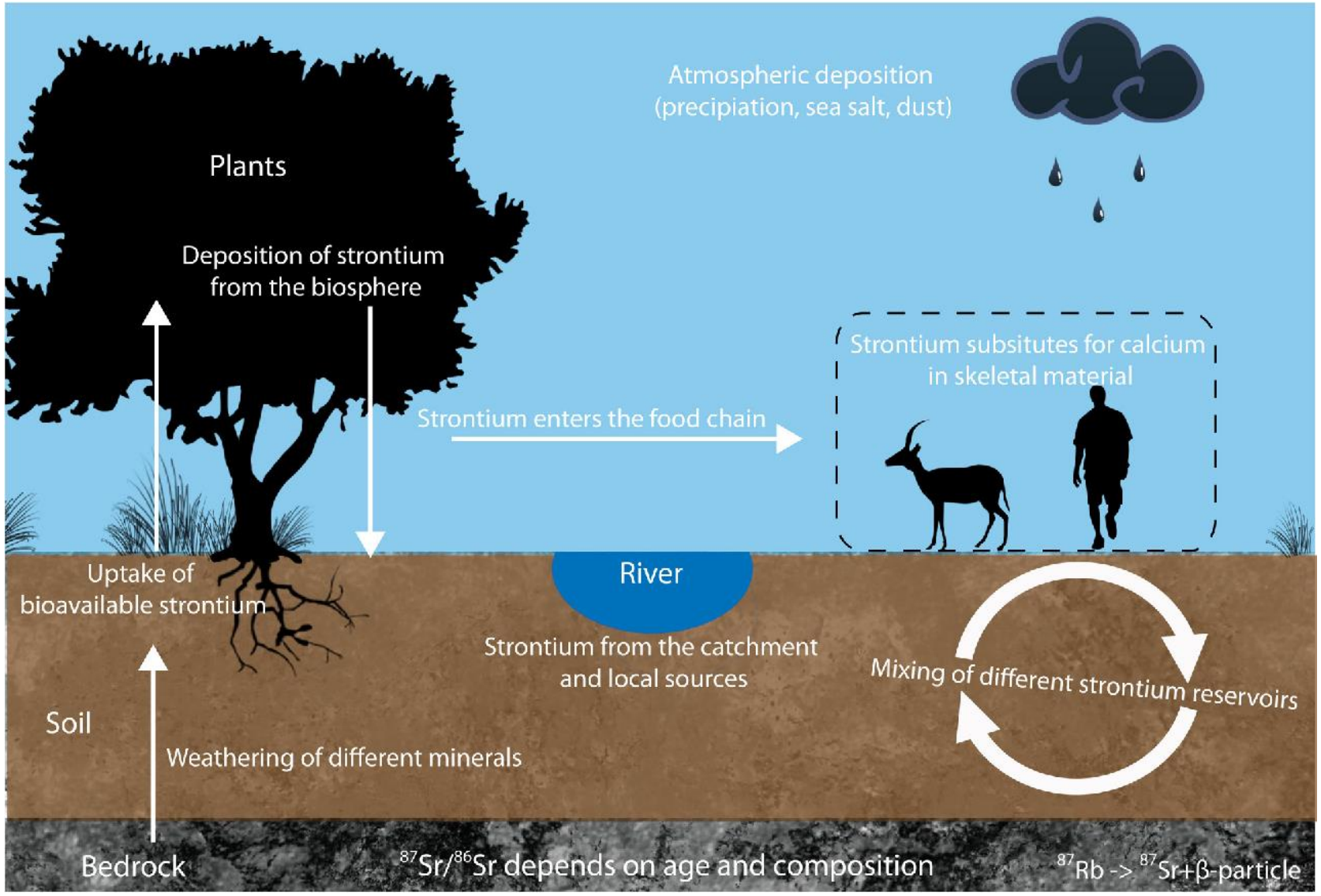
Microsampling Potential in Bone Hydroxyapatite:

Studies on **incremental dentin collagen** sampling to discern short-term changes in diet and stress may offer future insights into mobility practices involving juveniles.

Sudden changes in dietary intake, measured through carbon and nitrogen isotope values, could be indicative of juveniles' involvement in movement and consumption of isotopically different foods.

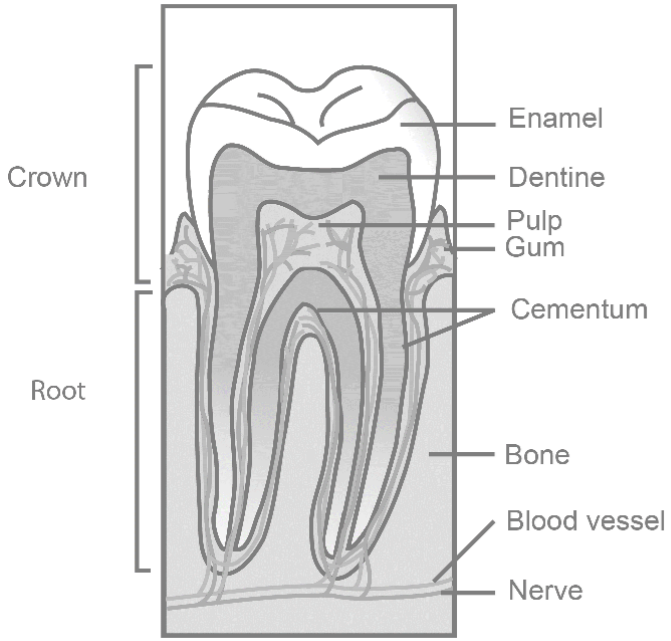
4.1. Radiogenic Strontium Isotopes

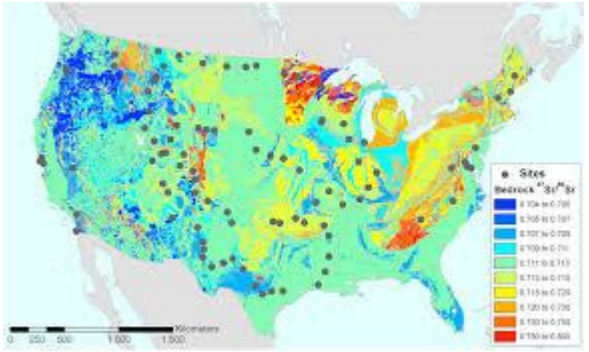
Simplified sketch of the strontium cycle showing important processes that affect the strontium composition before it reaches the skeletal material of animals and humans.



4.1. Radiogenic Strontium Isotopes

- Strontium isotope ratios (87Sr/86Sr) provide a now-common bioarchaeological measure of human movements across the globe.
- 87Sr varies in regional abundance relative to 86Sr, due primarily to underlying geologic differences in mineral age and type but also contributions from exogenous sources.
- Weathered bedrock releases strontium into surrounding soils and groundwater; due to its high atomic mass, 87Sr/86Sr ratios do not fractionate and pass unaltered into local plants & animals &, through their consumption, into humans.
- → 87Sr/86Sr ratios derived from human teeth or bone that differ from regionally bioavailable strontium may be indicative of mobility or migration event(s) at different stages of the life course prior to death and interment.





Volume XIV • Issue 1/2023 • 71–77

INTERDISCIPLINARIA ARCHAEOLOGICA
NATURAL SCIENCES IN ARCHAEOLOGY
homepage: http://www.iansa.eu

Locals or Migrants? Strontium Isotope Analysis of Two North-South Oriented Great Moravian Graves

Martina Fojtová[1*], Zdeněk Vytlačil[2,3]

[1]*Anthropos Institute, Moravian Museum, Zelný trh 6, 659 37 Brno, Czech Republic*
[2]*Department of Anthropology, National Museum, Václavské náměstí 68, 115 79 Praha 1, Czech Republic*
[3]*Department of Anthropology and Human Genetics, Faculty of Science, Charles University, Viničná 7, 128 43 Praha 2, Czech Republic*

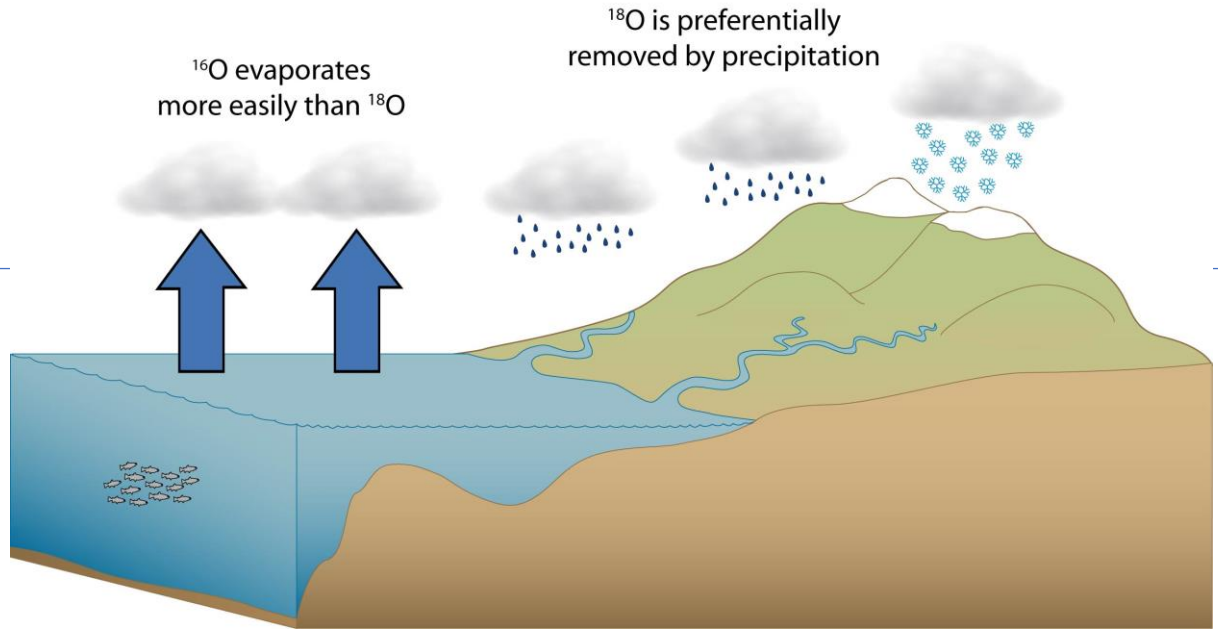
ELSEVIER

Journal of Anthropological Archaeology
Volume 31, Issue 4, December 2012, Pages 551-563

Strontium isotope analysis to reveal migration in relation to climate change and ritual tooth ablation of Jomon skeletal remains from western Japan

Soichiro Kusaka [a], Takanori Nakano [b], Wataru Morita [a], Masato Nakatsukasa [a]

4.2. Stable Oxygen Isotopes



- δ18O isotopes incorporated into human skeletal tissues reflect the geographic area in which these isotopes were ingested, enabling bioarchaeologists to assess past human movements.
- Regional differences in the amount of bioavailable oxygen isotopes from local meteoric and surface water (δ18Ow) derive from a composite averaging of multifaceted environmental contributors including air temperature, humidity, latitude, distance from the sea, and altitude
- Additional natural phenomena similarly affect local δ18Ow values in complex ways, ranging from flowing rivers to evaporation and seasonal fluctuations in precipitation
- Human δ18O body water values, in turn, are obtained primarily from the liquids that people drink, although other metabolic processes and cultural practices may also influence these values.

Journal of Archaeological Science: Reports
Volume 8, August 2016, Pages 416-425

Stable oxygen isotope evidence for mobility in medieval and post-medieval Trondheim, Norway

Stian Suppersberger Hamre [a], Valérie Daux [b]

PLoS One. 2016; 11(4): e0153850.
Published online 2016 Apr 28. doi: 10.1371/journal.pone.0153850
PMCID: PMC4849641
PMID: 27124001

On the Use of Biomineral Oxygen Isotope Data to Identify Human Migrants in the Archaeological Record: Intra-Sample Variation, Statistical Methods and Geographical Considerations

Emma Lightfoot[1] and Tamsin C. O'Connell[2,*]

Luca Bondioli, Editor

4.3. Other Isotopes

like radiogenic lead isotope ratios found in the underlying geology, vary regionally and contribute to assessing human mobility.

Debate exists on whether lead isotopes are primarily incorporated into human tissues through food and water consumption or if soil/dust inhalation and ingestion are more likely.

Lead isotope measures are effective when sampling pre-metallurgical populations, revealing geographic residence ratios. Cultural exposure in metallurgical societies shifts these ratios to reflect cultural residence.

Useful for distinguishing occupational, status, or ethnic/cultural groups and identifying nonlocal migrants with varying lead isotope exposure.

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RESEARCH ARTICLE

Lead (Pb) Isotope Baselines for Studies of Ancient Human Migration and Trade in the Maya Region

Ashley E. Sharpe, George D. Kamenov, Adrian Gilli, David A. Hodell, Kitty F. Emery, Mark Brenner, John Krigbaum

Published: November 2, 2016 • https://doi.org/10.1371/journal.pone.0164871

4.3. Other Isotopes

Stable Carbon & Nitrogen Isotopes:

Supplementary measures of mobility, reflecting differential access to certain foods and cultural preferences, aiding in investigations of group mobility, membership, and social identity.

JRI

Senior Honors Projects

Honors Program at the University of Rhode Island

5-2011

Carbon and Nitrogen Stable Isotopes in Fruits and Arthropods that are Eaten by Songbirds during Migration

Sarah E. Donlan
University of Rhode Island, donlan12087@my.uri.edu

The Bioarchaeology of Mobility and Migration in Action

1. Social and Ethnic Identities
2. Kinship Analysis & Postmarital Residence
3. Forced Migration & Enslavement
4. Contact, Interaction & Admixture
5. Climate Change
6. Disease Transmission

1. Social & Ethnic Identities

- Social identities can biologically impact individuals, leaving traces on skeletal remains. Embodiment theory emphasizes the biological inscription of social influences on the skeleton.
- Skeletal remains act as valuable indicators of group membership, particularly in populations where mobility or migration has shaped community composition.
- The skeletons of migrants **carry evidence of their journeys and subsequent biological and social adaptations to new environments, whether temporary or permanent.**
- Bioarchaeological methods aid in **identifying local populations and distinguishing nonlocal migrants**, contributing to the understanding of ethnic cohorts within past communities.

1. Social & Ethnic Identities

- ✓ Investigated the ethnicity & ethnic identity of individuals in a medieval Islamic cemetery in Ecija, Spain (8th–11th century AD).
- ✓ Examining 122 crania & observed significant craniometric variability → a biologically diverse population with affinities to both African and European groups.
- ✓ *Concluded that the Arab conquest of Iberia explains the diversity, proposing that Islam's expansion served as a unifying factor in identity construction amid the complex interplay of migration, religion, and conquest.*

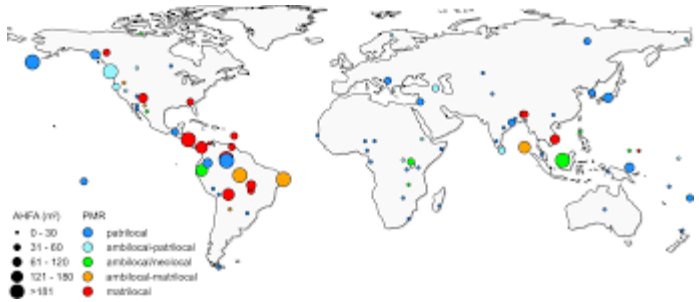
2. Kinship Analysis & Postmarital Residence

- Intra-cemetery analyses, indicative of relatedness between individuals, enable bioarchaeologists to identify biological kin or family groups at a single site, along with assessing postmarital residence patterns in the bioarchaeology of migration.
- Despite migration risks, the prospect of marriage, driven by sociopolitical or economic factors, motivated exogamous marriage in some past societies.
- Migratory practices, coupled with bioarchaeological insights into gendered behaviors, illuminate patterns of power, authority, inequality, socioeconomic status, and socially negotiated roles.
- Transnationalism and gender theory intersect, revealing bidirectional gendered mobility patterns that foster ongoing relationships between groups, impacting social identities constructed and navigated by migrants in both origin and post-migration cultures and environments, leaving indelible marks on skeletal remains.

2. Kinship Analysis & Postmarital Residence

- Bioarchaeological methods in kinship analysis & postmarital residence patterns provide a nuanced evaluation of relatedness, avoiding reliance on simplistic correlations between sex-specific grave goods and geographic or ethnic identity.

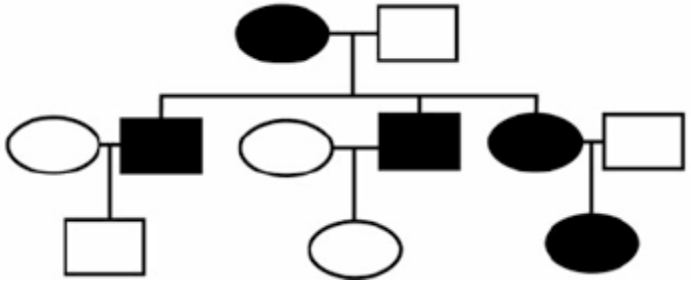
- Identification of nonlocals goes beyond matrilocality or patrilocality, revealing broader political and socioeconomic structures that unveil complex intraregional social organization and interregional interactions.



2. Kinship Analysis & Postmarital Residence

- Biological distance analyses, although rooted in Western and modern definitions of affinity, may not fully capture the importance of alternative, nonbiological kin structures:

1. fictive kinship,
2. fictive ancestry,
3. social relatedness prevalent among past populations.

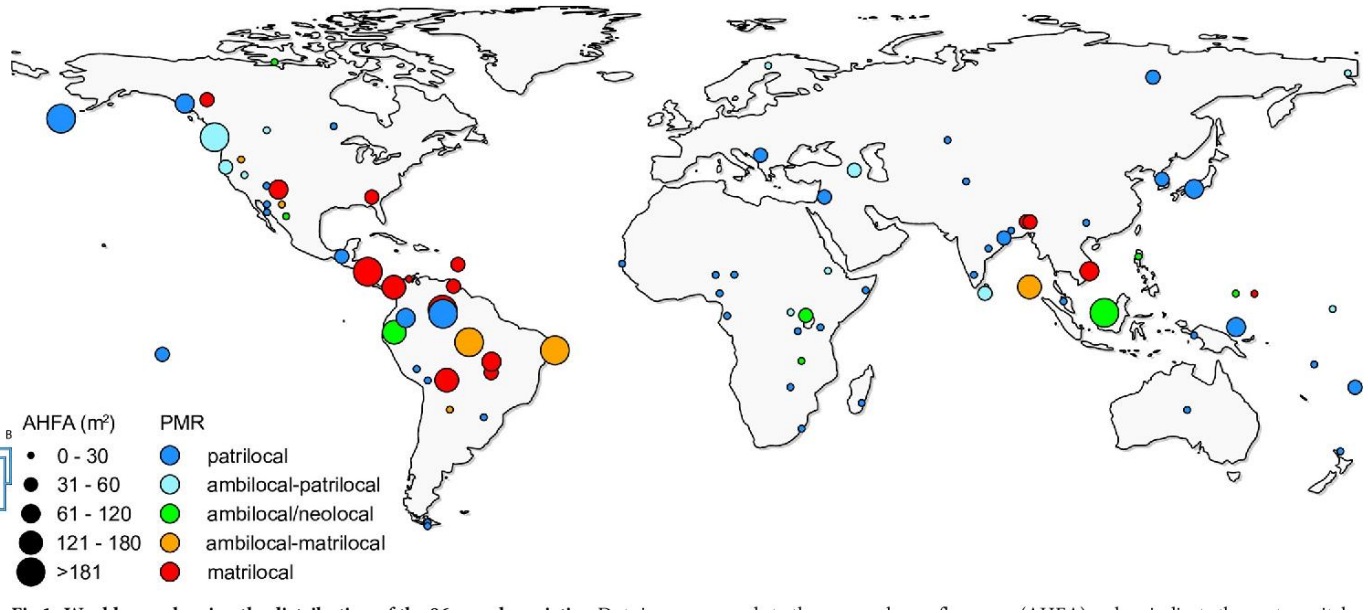


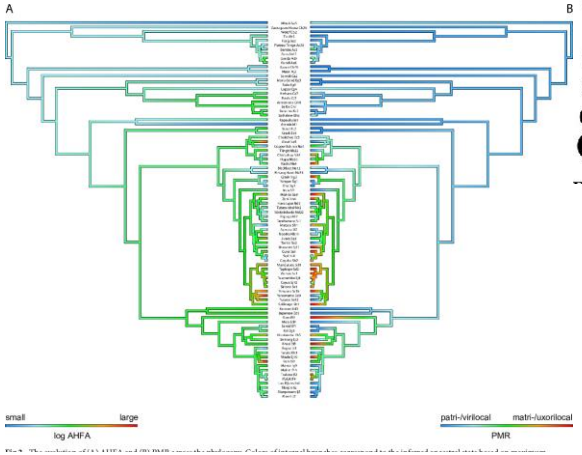
- Ethnographic examples highlight the diversity of such relationships in various cultural contexts, (Foster 1953; Mintz and Wolf 1950; Howell 2017; Lee 1979, 2003), and have also been recognized among immigrant populations (Ebaugh and Curry 2000), LGBTQ+ communities (Weston 1991), and Black and White American families (Allen et al. 2011; Chatters et al. 1994).

2. Kinship Analysis & Postmarital Residence

Bioarchaeological evidence of postmarital residential mobility is obtained through:

1. craniometric,
2. nonmetric,
3. dental metric,
4. nonmetric,
5. isotopic analyses.





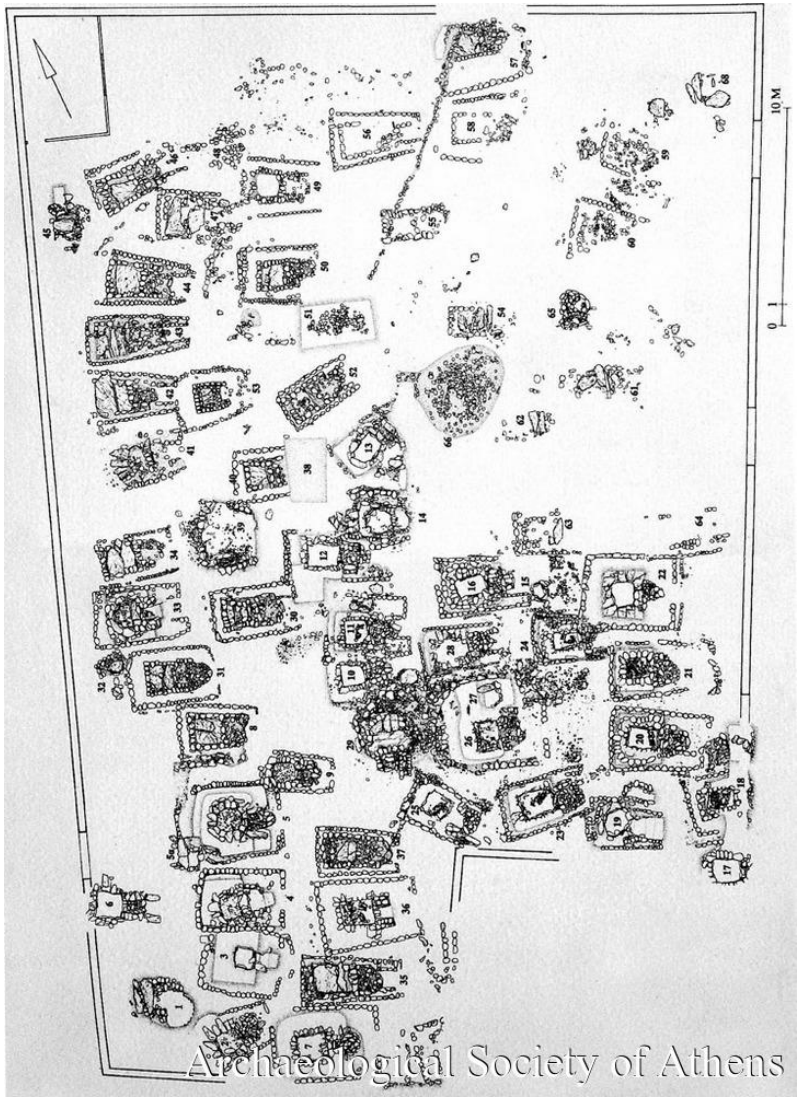
DOI: 10.1371/journal.pone.0229363 • Corpus ID: 211475326

Identifying post-marital residence patterns in prehistory: A phylogenetic comparative analysis of dwelling size

V. Hrnčíř, P. Duda, +2 authors J. Zrzavý • Published in PLoS ONE 24 February 2020 • Sociology

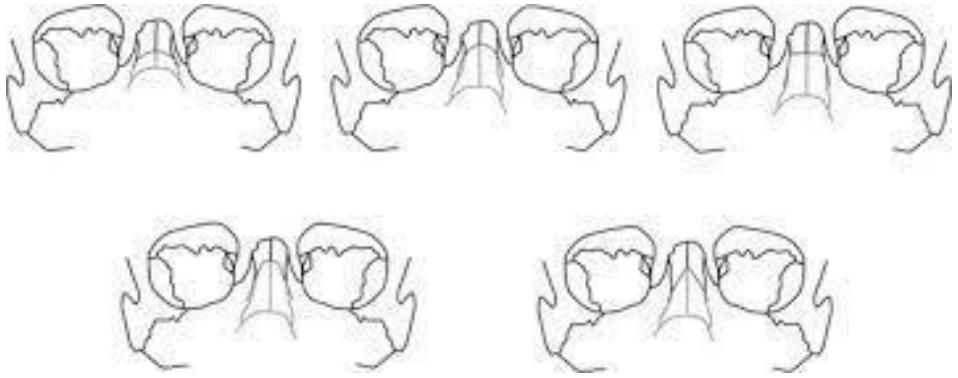
2. Kinship Analysis & Postmarital Residence

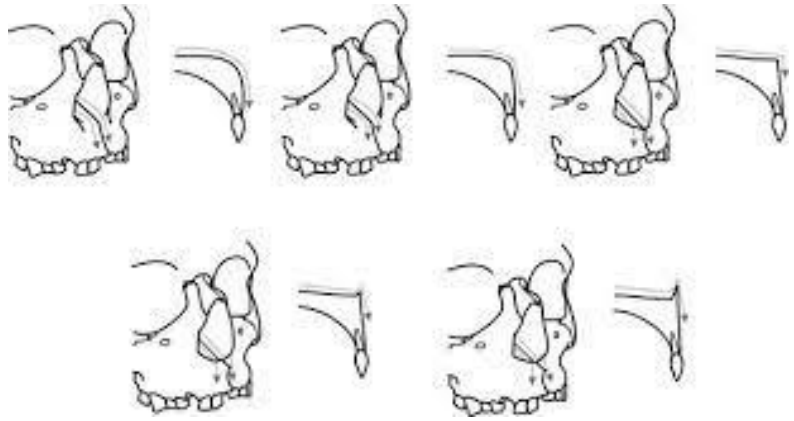
Tsepi cemetery in Marathon, Greece, reveals a matrilocal residence pattern with related females buried together.



2. Kinship Analysis & Postmarital Residence

- ✓ Males show increased cranial nonmetric trait variation, suggesting a postmarital strategy involving matrilocal females and migrating males, potentially influenced by economic factors and interregional trade networks.
- ✓ This sheds light on complex socioeconomic patterns shaped by migration and emphasizes the effectiveness of biodistance analyses in understanding social and biological identities.





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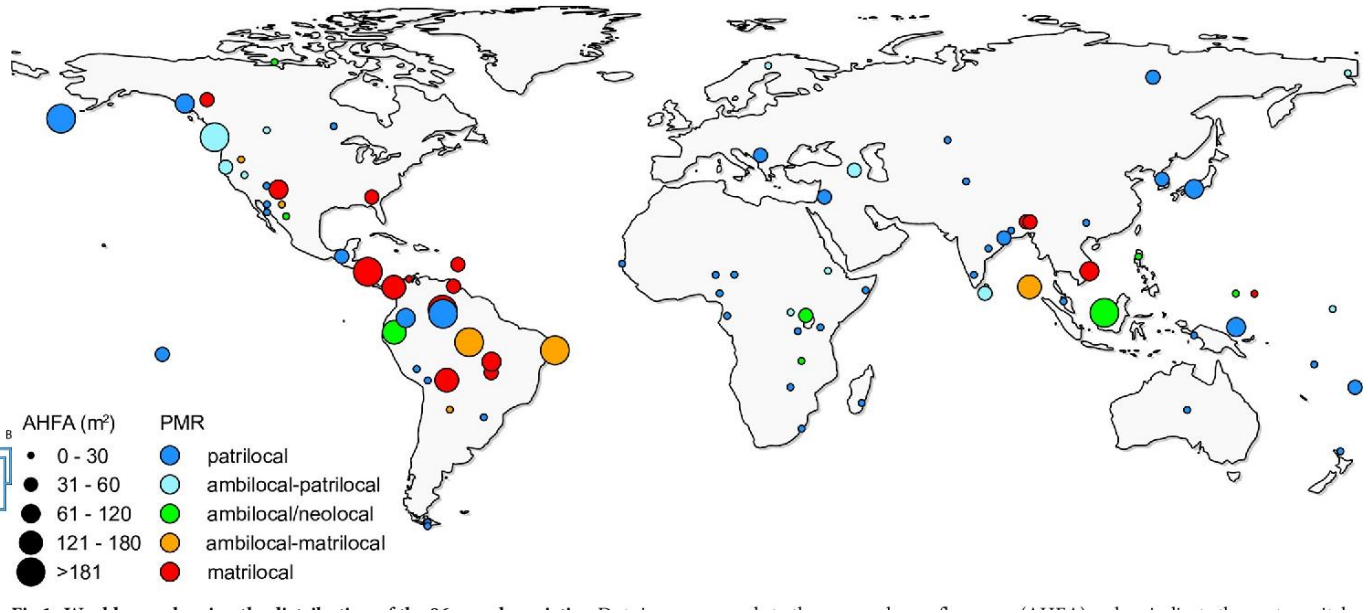
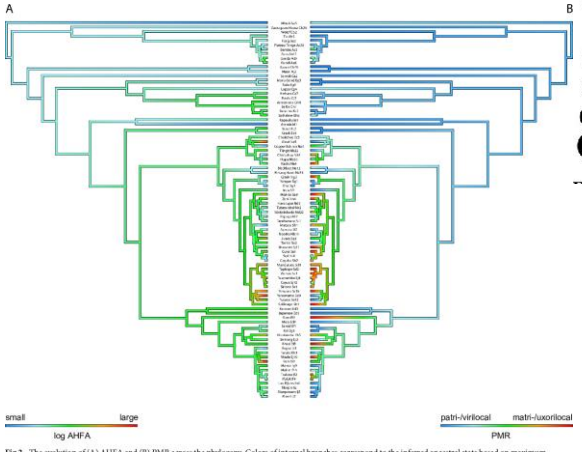




DOI: 10.1371/journal.pone.0229363 • Corpus ID: 211475326

Identifying post-marital residence patterns in prehistory: A phylogenetic comparative analysis of dwelling size

V. Hrnčíř, P. Duda, +2 authors J. Zrzavý • Published in PLoS ONE 24 February 2020 • Sociology

3. Forced Migration & Enslavement

- Bioarchaeological indicators of migration can offer valuable insight into not only mobility and subsequent social organization among communities in the past but also coerced movements and social control associated with enslavement (Blakey 2001; Harrod and Martin 2015).

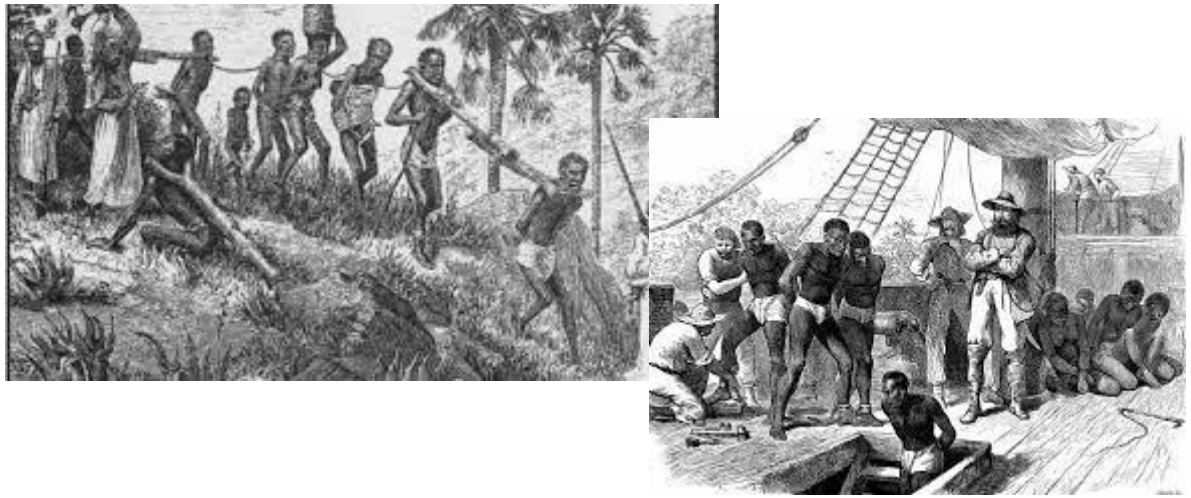
- Such studies better contextualize the circumstances surrounding the lives and deaths of those captive or enslaved women, men, and children whose voices are rarely heard in historic records (Harrod and Martin 2015).

- In particular, it offers a direct means of assessing pathways of forced migration as part of broader investigations into the exploitation of enslaved or captive individuals. By ascertaining such pathways, theoretically grounded examinations of structural violence suffered by those forced to cross sociopolitical or cultural borders can commence, including subsequent investigations into both physical violence and long-term stress (de la Cova 2012, 2017; Farmer 2004; Galtung 1969; Horevitz 2009; Klaus 2012; Nystrom 2014).

3. Forced Migration & Enslavement

Previous studies have attempted to track coerced movements and the geographic origins of such individuals using:

1. radiogenic and stable isotopes (e.g., Bastos et al. 2016; Cox and Sealy 1997; Goodman et al. 2009; Laffoon et al. 2018; Price et al. 2006, 2007; Schroeder et al. 2009; Tung and Knudson 2011; White et al. 2000, 2002),
2. dental modifications (e.g., Handler et al. 1982; Schroeder et al. 2014; Tiesler 2002; Wasterlain et al. 2016),
3. biodistance analyses (e.g., Coelho et al. 2017; Wasterlain et al. 2016),
4. aDNA analyses (e.g., Barquera et al. 2020).



3. Forced Migration & Enslavement

Examines skeletons from 15th–17th century urban disposal in Lagos, Portugal, identifying enslaved individuals through African-origin ornaments and tooth modifications resembling those from sub-Saharan Africa.

International Journal of Osteoarchaeology

Research Article

Dental Modifications in a Skeletal Sample of Enslaved Africans Found at Lagos (Portugal)

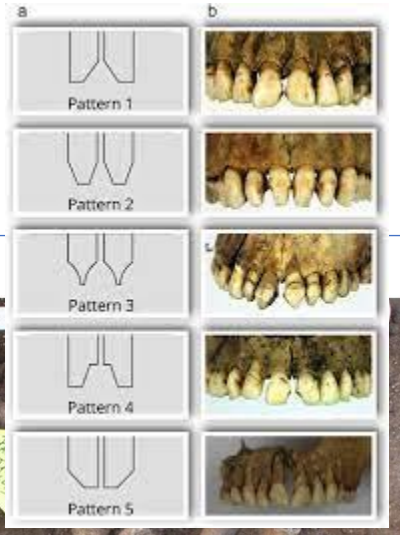
S. N. Wasterlain, M. J. Neves, M. T. Ferreira

First published: 24 March 2015 | https://doi.org/10.1002/oa.2453 | Citations: 23

3. Forced Migration & Enslavement

- ✓ Craniomorphometric analyses, contextual evidence, and burial details support the conclusion that these individuals were forcibly taken to Portugal from various African regions.

- ✓ The study underscores the significance of dental modifications in delineating social identity and highlighting coerced mobility, contributing valuable insights into understanding enslavement, colonialism, and structural violence.



4. Contact, Interaction & Admixture

The bioarchaeology of contact following mobility or migration, as well as subsequent short-term reactions and long-term biological and social adaptations to such encounters:

- *population replacement,*
- *admixture/gene flow,*
- *interpersonal violence,*
- *colonialism,*
- *Imperialism*

is strengthened by a deeper understanding of the role that mobility plays in patterns of interaction between two or more communities.

4. Contact, Interaction & Admixture

Enhances the bioarchaeology of contact following mobility or migration, focusing on Southeast Asia's population history.

By analyzing dental metrics and nonmetrics from over 4,000 individuals across Southeast and East Asia, the research supports the two-layered immigration hypothesis.

Notes and Comments

Dental morphology and the population history of the Pacific rim and basin: Commentary on Hirofumi Matsumura and Mark J. Hudson

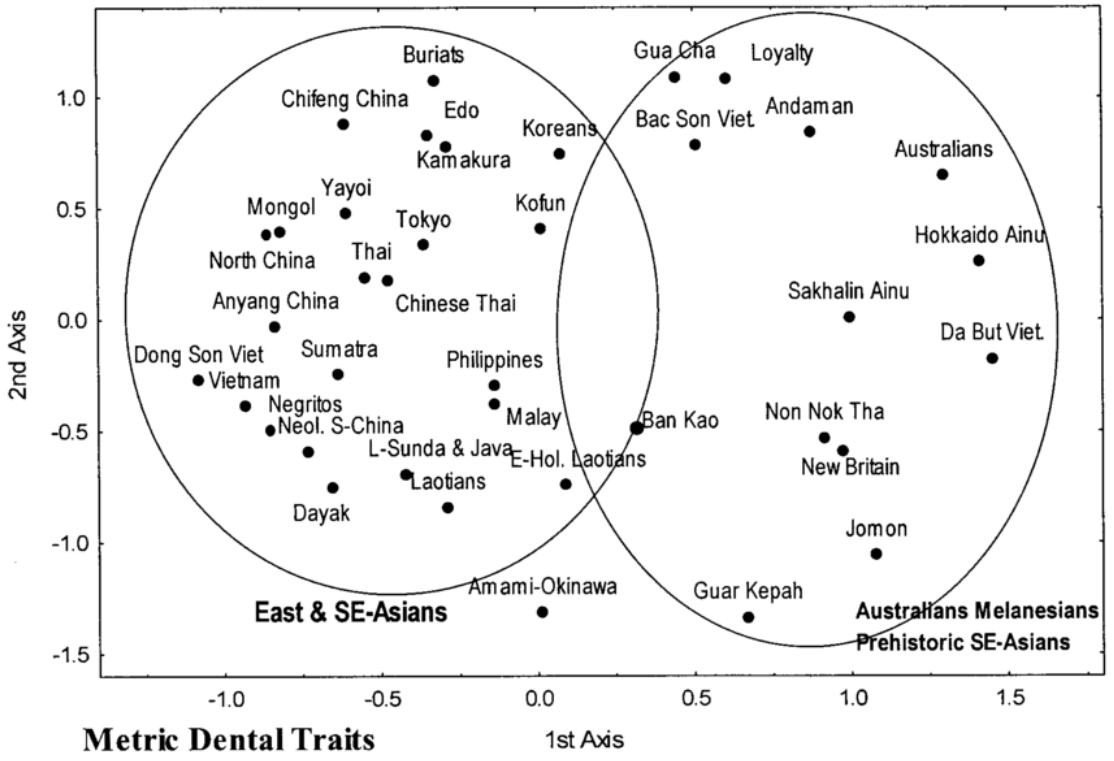
Christy G. Turner II

First published: 19 January 2006 | https://doi.org/10.1002/ajpa.20380 | Citations: 7

4. Contact, Interaction & Admixture

- ✓ It reveals close affinities between early Southeast Asian communities and Australo-Melanesian samples, indicating increasing admixture with East Asians over time, starting in the early Neolithic.

- ✓ The findings underscore the role of migration in shaping interactions and identities, emphasizing the impact on local Indigenous populations and the complex dynamics of biological and social shifts during contact.



Two-dimensional expression of MDS applied to distance matrix of Q-mode correlation coefficients of Table 5, based on dental crown measurements (males).

5. Climate Change

- Climate change impacts human communities by influencing their interactions with landscapes, neighboring populations, and socioeconomic structures.

- The bioarchaeology of resilience offers insight into how communities, facing environmental change, employ various adaptive strategies, including mobility & migration, as part of their efforts to cope with external stressors.

- Changes to mobility tied to climate change are perhaps best evaluated through isotopic analyses, as biogeochemical signatures provide a more direct measure of diachronic shifts in human movement over both an individual's life course and among community members within and across generations (Gregoricka 2016, 2020b; Knudson et al. 2015; Kusaka et al. 2012).

The Bioarchaeology of Mobility and Migration in Action

Am J Phys Anthropol. 2014 May;154(1):79-93. doi: 10.1002/ajpa.22474. Epub 2014 Jan 22.

Changing patterns of mobility as a response to climatic deterioration and aridification in the middle Holocene Southern Sahara

Christopher M Stojanowski [1], Kelly J Knudson

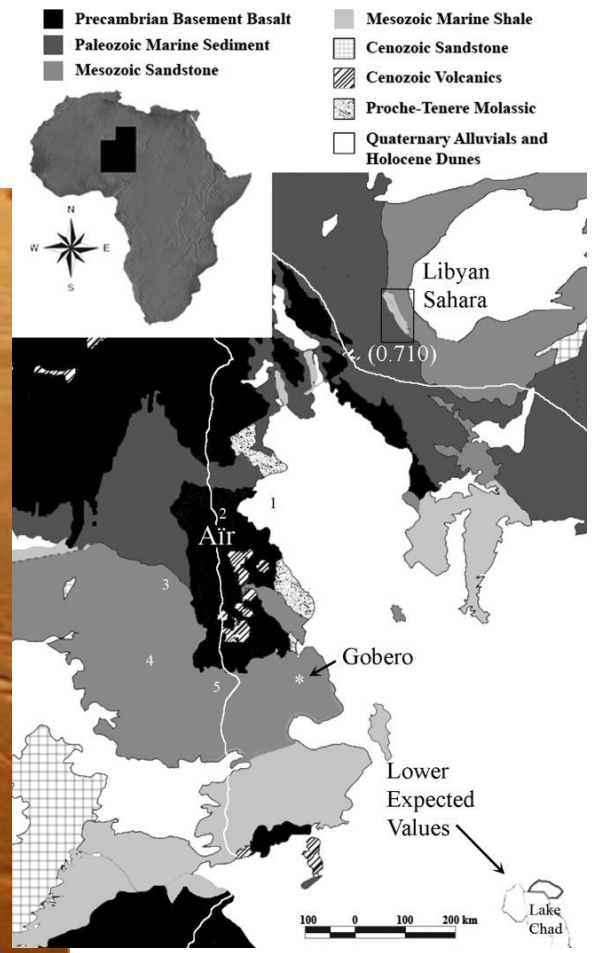
Affiliations + expand

PMID: 24449372 DOI: 10.1002/ajpa.22474

Gobero site (central Niger), a study using radiogenic strontium isotope analyses investigated the impact of aridity and climatic changes on local communities during the Early and Middle Holocene.

<u>The findings revealed that:</u>

1. in the wetter Early Holocene, first-generation adult migrants settled at Gobero, while juveniles showed local ratios, indicating a more sedentary lifestyle.
2. in the arid Middle Holocene, individuals exhibited nonlocal strontium isotope ratios → increased mobility as an adaptive response to water and/or food insecurity during severe arid phases.



5. Climate Change

The study *underscores the resilience of human populations in adapting to climate stress and suggests that smaller-scale societies may be more flexible in adjusting mobility in response to environmental changes compared to complex societies with rigid social hierarchies* (Robbins Schug 2020b).

6. Disease Transmission

Individuals in motion carry not only cultural traditions but also biological agents, including infectious diseases or disease vectors (Campbell and Crawford 2012; Findlater and Bogoch 2018).

Mobility significantly influences the geographic distribution of pathogens today, shaping disease landscapes (Bayer et al. 2009; Field et al. 2010; Findlater and Bogoch 2018).

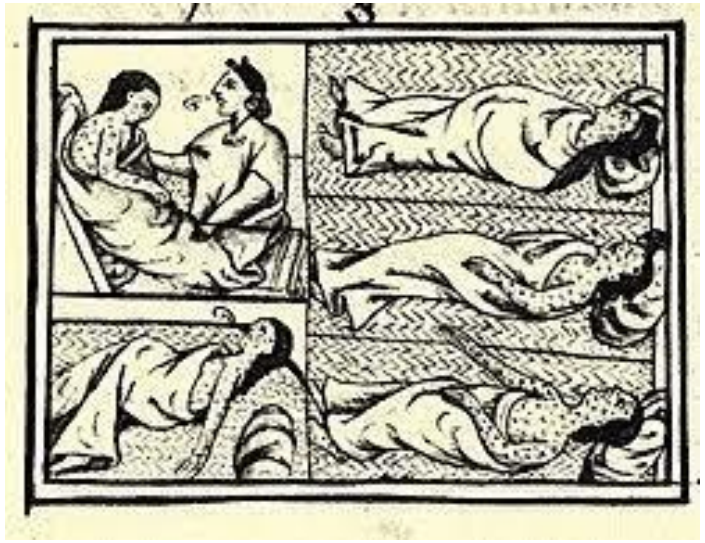
Historical Examples:

1. **European Colonization**: Smallpox introduction to the Americas led to devastating consequences (Boyd 1990; Lindo et al. 2016; Merbs 1992).
2. **Black Death**: The spread of the Black Death across Eurasia exemplifies historical disease migration (Andrades Valtueña et al. 2017; Spyrou et al. 2016, 2018).

6. Disease Transmission

Ongoing debates surround the origin and spread of diseases like treponematoses, posing questions about their Afro-Eurasian or American origins (Baker and Armelagos 1988; Baker et al. 2020; Cook and Powell 2012; Meyer et al. 2002; Powell and Cook 2005).

Assessing bioarchaeological evidence of disease transmission and its direct link to mobility patterns remains a challenging endeavor, with few studies delving into this intersection.

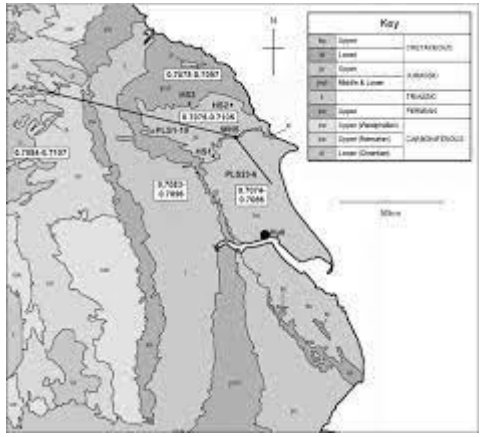


The Bioarchaeology of Mobility and Migration in Action

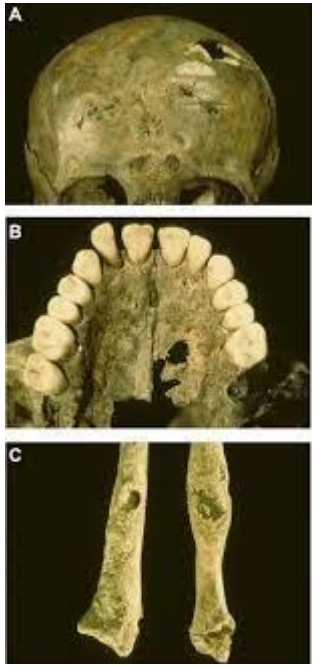
Isotopic tracing of the impact of mobility on infectious disease: The origin of people with treponematosis buried in hull, England, in the late medieval period

C.A. Roberts ✉, A.R. Millard, G.M. Nowell, D.R. Gröcke, C.G. Macpherson, D.G. Pearson, D.H. Evans

First published: 24 December 2012 | https://doi.org/10.1002/ajpa.22203 | Citations: 21

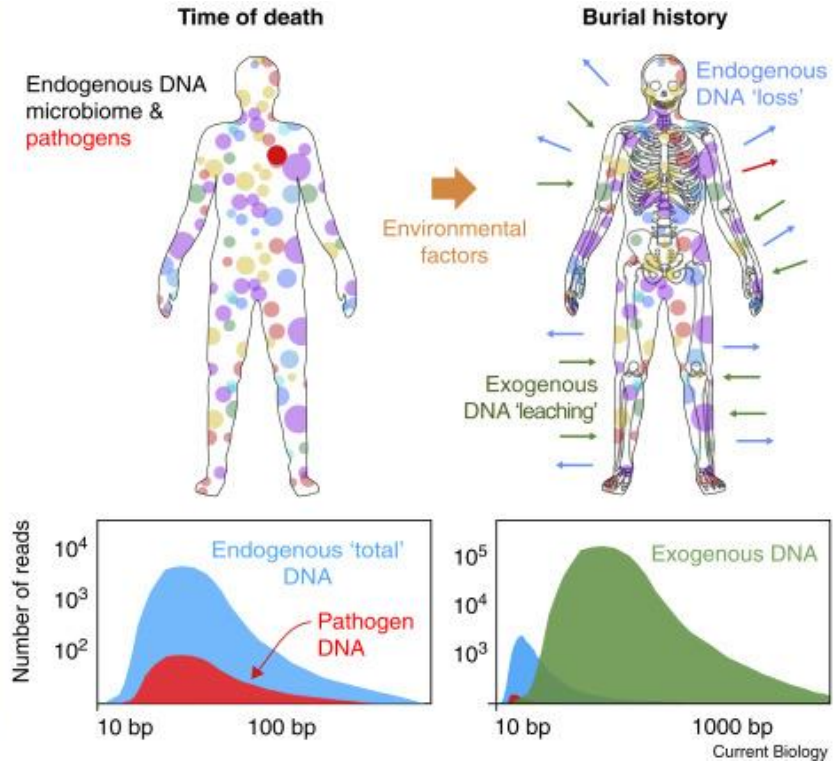


- ✓ investigating treponematosis in late Medieval Hull, dental enamel from individuals with treponemal lesions and controls was analyzed for strontium and oxygen isotopes.
- ✓ Despite identifying some migrants, the study found no clear link between childhood geographic origins and the expression of treponemal lesions.
- ✓ Initial results suggested that individuals could have contracted treponematosis in England rather than abroad, challenging the assumption that migrants played a significant role in the spread of treponematoses in Medieval England.



6. Disease Transmission

aDNA can similarly illuminate how migration among human populations can drive the spread of infectious disease. Such patterns of co-mobility are particularly revealing in the aDNA of pathogens extracted from human teeth or bone.



6. Disease Transmission

- ✓ Analyzed 563 skeletal samples from Late Neolithic & Bronz Age Russia and central/eastern Europe for Yersinia pestis.
- ✓ Identified a unique Y. pestis clade in the region, leading to tw possible scenarios:
- ✓ multiple entries over a millennium
- ✓ a single introduction from central Eurasia in the Neolithic.
- ✓ Integration of human genomic & archaeological evidence favored scenario 2 → the plague traveled with the Yamnaya westwards into Europe, demonstrating the synergistic value of combining aDNA from human & pathogen sources for refining archaeological interpretations of past mobility & disease spread.

Report

Current Biology

The Stone Age Plague and Its Persistence in Eurasia

Highlights

- Six Late Neolithic–Early Bronze Age European *Y. pestis* genomes were reconstructed
- All Late Neolithic and Early Bronze Age *Y. pestis* form a single phylogenetic branch

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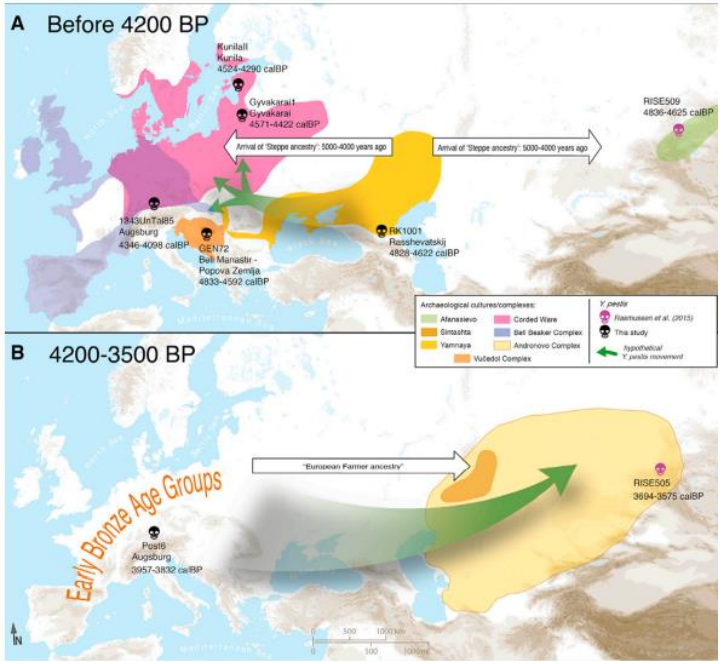
In Brief

Andrades Valtueña et al. present the first six European *Y. pestis* genomes dating from the Late Neolithic and the Early Bronze Age. These data suggest that *Y. pestis* entered Europe during a human migration around 4800 BP, persisted in Europe, and traveled back to Central Eurasia.



take-home message

Bioarchaeology has revitalized the study of past migration by advancing methodologies and theories, allowing the nuanced exploration of social organization, ethnic identities, gender roles, life courses, and disease transmission through observations of body modification, biological distance analyses, and biogeochemical and aDNA techniques.

Bioarchaeology challenges simplistic models of mobility, revealing its inherent complexity and heterogeneity shaped by diverse social, political, economic, and historical factors, emphasizing individual and group agency in migration decisions.

take-home message

Integrating theoretical models such as embodiment, structural violence, life course, and gender theory into bioarchaeological studies is essential for a nuanced understanding of past migration processes, emphasizing the importance of intersectional approaches.

Linking bioarchaeological perspectives with archaeological and anthropological theory, especially incorporating transnational concepts, can provide holistic insights into the complex dynamics of human movement, interaction, and identity construction across cultures and time.

Bioarchaeology emphasizes that mobility is intrinsic to human existence, urging a deeper exploration of the motivations and outcomes of past human movement, with a focus on those who migrate and the communities affected by their interactions.

take-home message

Bioarchaeology's practical applications, such as aiding in forensic anthropology for identifying migrant bodies, underscore its relevance to contemporary issues and contribute to understanding the motivations behind ancient migration.

Bioarchaeologists should enhance the relevance of their work on past mobility and migration by engaging with non-anthropological academic journals, adopting accessible language, and utilizing diverse outreach methods.

This approach aims to influence contemporary issues such as migration policy, disease transmission models, and demographic shifts, providing valuable insights from the long-term perspective of bioarchaeology.